REMEDIAL INVESTIGATION AND FEASIBILITY STUDY PLANS FOR LOW PRIORITY SITES

VOLUME IV

QUALITY ASSURANCE PROJECT PLAN

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT
GOLDEN, COLORADO

JUNE 1, 1988

ROCKWELL INTERNATIONAL
AEROSPACE OPERATIONS
ROCKY FLATS PLANT

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By [signature]
Date 12/10/91

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 SCOPE

The Quality Assurance Project Plan (QAPP) is intended to document the recommended practices that will be implemented during the field studies and supporting office work. The intent is to insure that the work performed will be accomplished in a controlled manner, fully compliant with applicable regulations and sound quality assurance practices. This Plan therefore prescribes the quality assurance requirements applicable to the administrative and functional organizations directly or indirectly related to the completion of this contractual agreement defined in the work plan.

2.0 QUALITY ASSURANCE PROGRAM

2.1 POLICIES AND QUALITY ASSURANCE OBJECTIVES

The purpose of the formal Quality Assurance Program is to establish policies to facilitate the implementation of regulatory requirements and to provide an internal means for control and review so that the work performed is of the highest professional standards. Quality Assurance personnel verify the implementation of the program through audits.

This project will be performed in conformance with Quality Assurance Program requirements and applicable federal, state, and contract requirements. Project objectives are as follows:

Scientific data generated will be of sufficient or greater quality to stand up to scientific and legal scrutiny.

Data will be gathered or developed in accordance with procedures appropriate for the intended use of the data.

Data will be of known and acceptable precision, accuracy, representativeness, completeness, and comparability as required by the project.

This Quality Assurance Project Plan (QAPP) has been prepared in direct response to these goals. This plan describes the Quality Assurance Program to be implemented and the quality control procedures to be followed by contractors and their subcontractors during the course of the CEARP Phase II activities for the low priority areas at Rocky Flats.

2.2 QUALITY ASSURANCE MANUAL

The program is documented in Corporate Quality Assurance Manuals.

The policies and procedures specified by the manual serve to define acceptable practices to be employed by personnel engaged in any particular project.

2.3 SOURCES OF INFORMATION

Sources of information contained or referred to herein have included:

Internal corporate technical procedures

Environmental Protection Agency (EPA) Quality Assurance Handbook (EPA-600/9-76-005)

"Proposed Sampling and Analytical Methodologies for Addition to Test Methods for Evaluating Solid Waste Physical/Chemical Methods," EPA, (PB85-103026)

American Society for Testing and Materials (ASTM) Standards; Section 11, Vols. 11.01 and 11.02, "Water," and Section 4, Vol. 04.08, "Soil and Rock, Building Stones"

American Public Health Association, "Standard Methods for the Examination of Water and Wastewater," 16th Ed.

"Methods for Chemical Analysis of Water and Wastes" (EPA-600/4-79- 020)

Federal Register, Vol. 49, October 26,1984, 40 CFR 136, pp.43234-43436

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA (SW-846)

"Handbook for Sampling and Sample Preservation of Water and Waste water," EPA (PB83-124503)

"Field and Laboratory Methods Applicable to Overburdens and Mine Soil," EPA (EPA-600.2-80-054)

"Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA (EPA-600/4-80-032)

USNRC Regulatory Guide 4.15, Rev. 1, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment"

"Chemical Analytical Services for Multi-Media Multi-Concentration Metals and Inorganics," EPA (WA-85-J839)

"Chemical Analytical Services for Multi-Media Multi-Concentration Organics, GC/MS Techniques," EPA (WA-85-J680)

2.4 REGULATORY DOCUMENTS

This Quality Assurance Project Plan has been designed to satisfy the intent and requirements of the following documents of the U.S. Nuclear Regulatory Commission (USNRC) and the U.S. Environmental Protection Agency (USEPA):

Title 10, Part 50, Appendix B of the Code of Federal Regulations, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"

American National Standards Institute (ANSI) NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities"

U.S. EPA, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," QAMS-005/80

U.S. EPA, "Technical Guidance Document: Construction Quality Assurance for Hazardous Waste Land Disposal Facilities," U.S. EPA/530-SW-86-031

3.0 PROJECT ORGANIZATION/MANAGEMENT

This section indicates the project organization and individual assignments. All participants are directly subject to the requirements of this Quality Assurance Project Plan.

3.1 AUTHORITY AND RESPONSIBILITIES

The responsibilities of individual positions for this project are described in the following sections.

3.1.1 CEARP Program Manager

The CEARP Program Manager will have primary management responsibilities for technical, financial, and scheduling matters. Other duties, as necessary, will include the following:

Procurement, along with Administrative personnel, and supervision of subcontractor services

Assignment of duties to the Project Staff and orientation of the staff to the needs and requirements of the project

Approval of project-specific procedures and internally prepared plans, drawings, specifications, cost estimates, and reports

Dissemination of project-related information from Rockwell and others

Serving as liaison between the Project Staff and other internal groups; such as Quality Assurance, Health and Safety, and the laboratories

Serving as the "collection point" for Project Staff reporting of nonconformances and changes in project documents and activities

Determination of the effect of the nonconformances and changes on the project

Notification of the Project Group, and Quality Assurance personnel, of the project nonconformances and changes

Review of project documents

3.1.2 CEARP Field Manager

The primary role of the CEARP Field Manager will be to directly supervise and coordinate the activities of the technical staff and subcontractors. The CEARP Field Manager will also assist the CEARP Program Manager in monitoring the project schedule, budget and proper conformance to project plans.

3.1.3 Subcontractor Site Manager

Activities performed in the field shall be under the immediate direction of a Subcontractor Site Manager. The Manager will coordinate activities and ascertain that proper techniques and procedures are being performed on a site specific basis. The Manager is responsible that field crews collect, record, and transmit data and samples by appropriate Quality Assurance procedures as dictated in this Quality Assurance Project Plan.

3.1.4 Laboratory Managers

Responsibilities of each Laboratory Manager shall, as appropriate, include:

General supervision of laboratory

Collaboration with the Project Group in establishing sampling and analysis and testing programs

Schedule and execution of testing programs

Serving as liaison between the Laboratory Staff and other personnel

Serving as the "collection point" for Laboratory Staff reporting of nonconformance and changes in laboratory activities

Notification of the Laboratory and Quality Assurance personnel of specific laboratory nonconformances and changes
Maintenance of laboratory data and checkprints

Release of testing data and results; reporting analyses to the CEARP Program Manager

Calibration of laboratory equipment

Storage and disposition of samples

3.1.5 Quality Assurance Officer

The Quality Assurance Officer is responsible for the development of this plan and the day-to-day control of project quality assurance/quality control activities. The Officer will provide the necessary guidance to the Project Personnel on quality-related matters and perform the project audits. The Officer has the authority and freedom to identify problems of quality; initiate, recommend, or provide corrective actions; and

verify the implementation of the corrective actions. The Officer's other duties include the following:

Notification of personnel of nonconformances and changes in quality assurance procedures

Determination of audit schedule and performance of project audits

Conduct on-site quality assurance inspections

Review and approval of project-specific technical documents

3.1.6 CEARP Health and Safety Coordinator

The Director's responsibilities, as appropriate, include:

Administration of the corporate Health and Safety Program

General supervision of health and safety activities

Oversee the subcontractor Health and Safety Coordinator

3.1.7 Subcontractor Health and Safety Coordinator

The Subcontractor Health and Safety Coordinator is responsible for the development of the project Health and Safety Plan and the day-to-day control of environmental and health and safety activities. The Coordinator will provide the necessary guidance to the Project Personnel so they can safely perform their functions in accordance with federal, state, and Rocky Flats regulations.

Develop and implement Health and Safety Plan

Establish all engineering and administrative personal, protective equipment controls.

Supervise medical surveillance
Provide site-specific health and safety training

Conduct site Health and Safety inspections for compliance to the Health and Safety Plan

Coordinate all internal plant logistics

3.2 SCHEDULING AND REPORTING

Project management shall, as appropriate, define and document the technical and administrative milestones. It shall be the responsibility of the project manager to document unusual or unexpected occurrences during the life of the project that will adversely impact the project schedule. Where appropriate, these will be documented as nonconformances (see Section 9.3.2).

The schedule shall be developed at the Task and Subtask level. It shall be based on a detailed Work Breakdown Structure. Wherever possible, automated methods shall be used to plan and schedule the detailed work efforts, monitor progress, and provide timely reports on status. These reports shall also include accomplishments and identifications of corrective action as necessary. Automated methods for pert charting, timeline development and their visual display shall be used as well.

The first report will be scheduled every two weeks after the start date for the project. A schedule to include milestones of the Task and Subtask levels will be provided following approval of the final work plan.

4.0 EQUIPMENT CALIBRATION/MAINTENANCE

Measuring and test equipment used in the field and laboratory shall be controlled by a formal calibration program. The program shall provide equipment of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Calibration of measuring and test equipment may be performed internally using in-house reference standards, or externally by agencies or manufacturers.

4.1 RESPONSIBILITIES

The responsibility for the calibration of laboratory equipment rests with the applicable Laboratory Manager. The Subcontractor Site Manager is responsible for the calibration of the contractor's field and Health and Safety equipment.

4.2 CALIBRATION PROCEDURES

Documented and approved procedures shall be used for the calibration and measuring of test equipment. Whenever possible, widely accepted procedures, such as those published by the ASTM or EPA, or procedures provided by manufacturers in equipment manuals, shall be adopted. The person using the equipment is responsible for that equipment's calibration.

Equipment shall be uniquely identified by using either the manufacturer's serial number, or a unique identification number. This identification, along with a label indicating when the next calibration is due (only for equipment not requiring daily calibration), shall be attached to the equipment. If this is not possible, records traceable to the equipment shall be readily available for reference.

It is the responsibility of all personnel to check the calibration status from the due date labels or records prior to using the equipment.

Measuring and test equipment shall be calibrated at prescribed intervals and/or as part of operational use. Frequency shall be based on the type of equipment, inherent stability, manufacturer's recommendations, values given in national standards, intended use, and experience (Tables 5-1 and 5-2). Equipment shall be calibrated, whenever possible, using reference standards having known relationships to nationally recognized standards (e.g., National Bureau of Standards, NBS) or accepted values of natural physical constants. If national standards do not exist, the basis for calibration shall be documented.

Reference standards (physical, radiological, and chemical) shall be used only for calibration. Standards shall be stored separately from measuring and test equipment. Equipment that fails calibration or becomes inoperable during use shall be removed from service and segregated to prevent inadvertent use, or shall be tagged to indicate it is out of calibration. Such equipment shall be repaired and satisfactorily recalibrated to the satisfaction of the Laboratory Manager or Subcontractor Site Manager or CEARP Health and Safety Coordinator, as applicable. Equipment that cannot be repaired shall be replaced.

Records shall be prepared and maintained for each piece of calibrated measuring and test equipment to indicate that established calibration procedures have been followed. Records for subcontractor field equipment used only for this specific project shall be kept in the project files. Records for equipment used in the laboratory shall be maintained by the appropriate laboratory.

4.3 PREVENTIVE MAINTENANCE

Periodic preventive maintenance is required for equipment. Instrument manuals shall be kept on file for reference purposes, should equipment need repair. Troubleshooting sections of manuals are often useful in assisting personnel in performing maintenance tasks. Equipment maintenance and/or repair that exceeds a routine nature shall be performed by qualified or certified personnel.

Laboratory environmental equipment requiring routine maintenance will have an individual instrument file indicating the frequency of required maintenance, maintenance history, spare parts maintained by the laboratory, directions for maintenance, and any external service contracts. Major instruments in the laboratories may be covered by annual service contracts with the manufacturers. Under these agreements, regular preventive maintenance visits shall be made periodically as needed by trained service personnel.

5.0 SITE INVESTIGATION AND SAMPLING

This section of the Quality Assurance Plan present the scope and methodology of field investigation, sampling, and testing activities at the Rocky Flats site. All of these activities including collection, analysis, preservation, packaging, handling, shipping, and storage of samples will be performed in accordance with EPA, NIOSH, DOT, ASTM or DOE protocols.

5.1 SCOPE OF FIELD ACTIVITIES

The site will be investigated using surface sampling, subsurface borings, and in situ testing to evaluate the following aspects:

Hydrogeology

Surface Hydrology

Site soil stratigraphy

Contaminants present in soil, air, biota, ground water, surface water, sediment, sludge, surface wastes, concrete, asphalt, and other materials

Information obtained from site investigation activities shall be recorded and documented. Required documentation of field investigation and testing includes a daily log of project activities; and the appropriate subsurface logs, test data forms, piezometer/well installation forms, and field collection forms. Examples of this documentation are shown in Figures 5-1 through 5-6.

5.2 QUALITY OBJECTIVES

All field measurements and sample collection procedures shall be performed such that they are representative of the media and the conditions that are present. The specific process will be of sufficient accuracy and precision to meet or exceed the objectives of that particular effort. Analytical duplicates and blanks will be collected to meet the specific requirements of the activity. Sources of error will be identified and documented, and procedures implemented to eliminate the problem.

Members of the Project Team working in field operations shall keep a daily log of the project activities. Items to be included in the daily log, as appropriate, are:

- Field activity subject
- General work activity
- Unusual events
- Changes to plans and specifications
- Visitors on site
- Subcontractor progress or problems
- Communication with Rockwell, regulatory agencies, or others
- Weather conditions
- Personnel on site

Copies of the daily log entries should be sent to the CEARP Field Manager approximately on a weekly basis. If the logs are not submitted as required, it is the responsibility of the CEARP Manager to correct the situation.

All photographic activities will be cleared through the Rocky Flats Security Department. All photographs will be taken, developed, and controlled by Rocky Flats Security.

Appropriate test data forms shall also be prepared. They shall include, as appropriate, the test location (e.g., boring, depth, sampling station, elevation, and field coordinates) and the applicable items listed in Section 7.5 for laboratory test data forms.

Field records shall be collected and maintained by the Subcontractor Site Manager until completion of the field program phase, or until they are submitted to the project central file. During the performance of the field program, it is anticipated that a copy of the field records will be periodically made and sent to the CEARP Field Manager. This may be done at the Manager's request.

These copies can provide adequate documentation of work activities should the originals be destroyed, lost, or stolen.

5.3 FIELD METHODS AND SAMPLING INFORMATION

The following considerations form the basis for the site-specific sampling program:

- Frequency of sampling
- Location and number of monitoring stations to be sampled
- Methods of sampling to be employed
- Media to be sampled
- Number of samples to be collected
- Volume of samples to be collected
- Type and kind of analyses to be performed in the field
- Type and kind of analyses to be performed at the laboratories
- Procedures and precautions to be followed during sampling
- Methods of preservation and shipment

Sampling shall be frequent enough to identify materials and to describe important material changes. Methods of sampling employed shall preserve the integrity of material parameters.

The general procedures listed below are applicable to the implementation of the field sampling program:

Calibrate field equipment prior to field work according to manufacturer's instructions or internal procedures.

Complete a sample field collection report prior to leaving the field location.

Label all sample containers with appropriate information.

Complete chain-of-custody records (Figure 7-1) and request for analysis forms (Figure 6-7) which will accompany samples during shipment that require chemical, radiological, and physical analysis.

Samples obtained for chemical and radiological analysis shall be collected and maintained in appropriate containers in accordance with the specific procedures cited in Tables 5-1 and 5-2.

Containers of the appropriate volume and material shall be cleaned in the laboratory and shipped to the site under conditions that guarantee cleanliness prior to testing in accordance with the following procedures:

For General Chemical Determinations - Standard Methods, 15th edition, 1980, Page 4

For Metals and Radiological Determinations - Standard Methods, 15th edition, 1980, Page 142

For Organics Determination - Annual Book of ASTM Standards, Section 11, Volume 11.02, "Standard Practices for Preparation of Sample Containers and for Preservation of Organic Constituents," D3694; and Federal Register, Vol. 49, October 26, 1984, 40 CFR 136, pp. 43234- 43436

Container materials, sample volumes, and preservatives are listed in Tables 5-1 and 5-2. Containers shall have tight, screw-type lids and may contain appropriate preservatives prior to use.

Sampling equipment shall be decontaminated thoroughly to minimize sample contamination and cross contamination. The general methodology is to thoroughly scrub the equipment with phosphate-free detergent and then rinse successively with distilled water, methanol, and distilled water again. See Section 5.3.10 for detailed decontamination procedures and the Environmental, Health and Safety Plan for further decontamination procedures. The Field Supervisor may propose alternate methods as per Section 8.3.

Samples obtained only for geotechnical analysis will be collected and maintained such that their integrity is preserved and they remain representative of the conditions and materials from which they were sampled.

5.3.1 Surface Rock and Soil Sampling

Surface soil and rock samples will be collected from specific sites as needed to determine the near surficial extent of contamination from sources.

Grab samples (samples collected without regard to a survey) will be collected as needed to help define contamination on a reconnaissance level. For detailed work, soil samples will be located and collected on an equally spaced grid with

one line direction staggered 50 per cent of the distance. The grids will be designed and uniquely numbered such that they can be entered and managed in a computer data base. Location and density of samples will be determined based on the characteristics of the contaminant, probable pathways of release, coordination with other sampling methods, presence of bedrock, and other requirements necessary to characterize near surface dispersion. In any case, detailed sampling will be performed in such a means that a sufficient number of samples are collected to confidently define contamination boundaries and areal extent.

Detailed surficial sampling techniques will be used to assess possible radionuclide resuspension contamination

Two foot long Shelby tubes or durable sampling trowels will be used for collecting soil. A standard geologist's pick will be used for rocks. Sampling equipment will be decontaminated prior to use. See Section 5.3.10.

Rinsate blanks and Field and Trip blanks shall be collected as per Section 5.3.11.

The sample will be placed in the appropriate container and put in a cooler (ice chest) with "blue ice," or equivalent, and maintained at approximately 4 degrees Celsius.

All pertinent field information will be recorded on forms specifically for surface rock and soil sampling.

Chain-of-custody and request for analyses forms will be completed.

Samples will be delivered to the laboratory or commercial carrier.

5.3.2 Subsurface Rock and Soil Sampling

Subsurface borings allow for sampling of soils and bedrock at depths to investigate possible contamination.

The location of borings will be determined by site specific characteristics of contamination pathways and sources. Where justified, the borings and sampling will occur in conjunction with drilling for monitoring wells.

Hollow stem augers will be used to advance the boring in unconsolidated material. As appropriate samples of soil will be collected continuously through an inner barrel in a split tube or discretely by split spoon. Samples will be collected every five feet or as determined by the site geologist. Drilling muds or other foaming agents are not allowed. Organic-free water may be used for hole stability problems.

Rotary coring will be used where necessary to sample bedrock. Hollow stem auger methods may be employed to advance the boring in unconsolidated material that overlays bedrock. Appropriate methods for setting casing will be used. If the hole requires treatment in the bedrock, bentonite mud, volatile organic-free water, or air may be used. Volatile organic-free water is to be the first choice.

Samples will be placed in an appropriate container (See Table 5-2) for the requested analyses. Cores from tubes or split spoons will be handled properly to maintain an undisturbed state for geotechnical parameters or placed in appropriate containers for chemical or radiological analyses.

Equipment will be decontaminated as per Section 5.3.10.

Equipment and Field and Trip blanks will be collected as per Section 5.3.11.

A descriptive log of subsurface material will be maintained that describes the following, as applicable:

- Borehole name and location
- Initial contact with ground water
- Description of soil, e.g., consistency, color, density, etc.
- Blows on sampler, in accordance with ASTM, Standard Penetration Test, D1586
- Percent recovery
- RQD
- Structures
- Fracture density and orientation
- Lithology including textures and structure (Unified Soil Classification System for Soils)
- Visual description of contaminants
- Hardness
- Local cultural items, e.g., buildings, towers, pipes, etc.
- Sampling personnel, weather conditions, visitors
- Signature of lead sampler

Proper chain-of-custody and request for analysis forms will be prepared.

Samples will be delivered to a laboratory, storage area, or commercial carrier, as appropriate.

5.3.3 Monitoring Well Installation

Monitoring wells will be established to gather information on ground water parameters and to collect water for analyses (see Figure 5-9):

Two or four inch PVC casing may be used. Factory slotted PVC well screens will be installed in ten foot or shorter sections.

Sand, 16-32 in size will be placed in the annulus around each well screen. A minimum one foot thick bentonite seal will be placed above the filter pack. A mixture of 95 percent neat cement (Portland Type II) and five percent bentonite will fill the remainder of the annulus to the surface. A three-foot diameter concrete pad will be poured, cementing in a four or six-inch protective casing with a locking cap over the riser pipe. All locks will have a common key. The pad will be constructed with a slope away from the well and will be set several inches below the ground surface.

Where wells enter bedrock, rotary methods may be used if hollow stem auger methods prove inadequate. Borehole casing must be established down to the subcrop and cemented in place for 24 hours before boring advancement into the bedrock. The casing must adequately seal and prevent cross contamination between aquifers.

Well development will be performed until turbidity has stabilized. Organic-free water will be introduced into the well, if necessary, to completely develop the sand pack. In such instances, the well will be filled to fully saturate the sand pack, surged with a surge block, or bailed and

removed with a pump or bailer. This is repeated three (3) times. Formation water and introduced water will be removed with a bailer or pump until turbidity stabilizes. This is usually five (5) to seven (7) maximum well storage volumes.

All material removed during drilling and well development shall be handled as specified in the JSA (see Health and Safety Plan). If contamination is found, proper disposal methods will be employed.

Well casing elevation and location will be surveyed to the nearest hundredth of a foot. Rocky Flats coordinates will be used for documenting its location.

In situ falling head and/or rising head tests (slug tests) will be conducted to determine well sensitivity and hydraulic conductivity in accord with the following methodology:

- Stainless steel slugs of appropriate scale for the well will be emplaced or withdrawn with polypropylene rope. The rope will be of sufficient size to retain the slug with a minimal effect on the water volume.

- The initial water level will be measured with an electrical water level indicator that is accurate to 0.01 feet.

- A pressure transducer of an appropriate range that is accurate to 0.01 feet and capable of measuring water-level changes of approximately 20 feet shall be used. A digital data logger will be used to record changes in head.

- The transducer shall be placed at a level in the well

such that it remains below the lower limit of the slug and beneath the water level.

- Equipment will be decontaminated as per Section 6.3.10, between tests on each well. A clean rope will be used for each well. The used rope will be disposed of properly.

- Wells shall be analyzed by the Cooper, Bredehoeft, and Papadopulos (1967) method or the Bower and Rice method (1976) for confined and unconfined aquifers, respectively. Alternate methods may be used if so agreed to by Rockwell.

Packer tests shall be performed to analyze selected zones in cored open boreholes in accord with the following guidelines:

- The packer(s) will be emplaced to isolate the zone and inflated to an appropriate pressure.

- A head of water in excess of the potentiometric level of the tested zone will be produced by means appropriate for the gross conductivity of the zone being tested.

- Equipment will be decontaminated as per Section 6.3.10.

- Hydraulic conductivity will be calculated by an analytical method outlined above.

5.3.4 Groundwater Sampling Procedures

Ground water will be sampled to assist in the characterization of contaminant plumes. Detailed sampling procedures customized for

Rocky Flats conditions will be followed. In general, these procedures are:

The protective cap will be removed from the well and care taken to keep the cap clean.

Three volumes of standing water shall be purged from the well (0.162 gallons/feet for two inch diameter; 0.652 gallons/feet for four inch diameter wells), or until dry. Purged water will be disposed of as appropriate (see JSA).

A stainless-steel bailer and polypropylene will be used to sample the well soon after purging. Water will be collected for volatile organic analysis first (within the first three hours), if the well recovers slowly.

The bailer will be raised and lowered such that there is minimum disturbance to the well water.

Groundwater collected for analyses will be filtered, where appropriate, (Table 6-1). The containers will then be filled with the groundwater and the appropriate preservative added if container did not previously contain preservative. The water collected for volatile organic analyses will be performed such that air is excluded.

Decontamination will be performed as per Section 6.3.10.

Equipment and Field and Trip blanks will be collected as per Section 6.3.11.

Bottles will be rinsed with distilled water

Samples will be placed in a cooler with "blue ice" or equivalent and maintained to approximately 4 Celsius.

Groundwater field tests for pH, temperature, and specific conductance will be performed immediately before, during, and after sampling.

Appropriate field information will be recorded on forms dedicated to ground water sampling.

Chain of custody and request for analysis forms shall be completed.

Samples will be delivered to the laboratory or common carrier.

5.3.5 Surface Water Sampling

Surface waters will be collected from ponds, streams, springs and seeps as judged necessary to characterize possible contamination. Surface waters will be sampled in conjunction with the ground water and analyzed for the same parameters.

The sample container and cap will be rinsed in the water to be sampled.
The water will be sampled to collect a representative sample. Sediment fractions should be kept to a minimum.

The necessary preservative(s) will be added, if container did not previously contain preservative, and the cap replaced on the container. Care will be taken on samples for volatile organic analyses that air is not present in the filled container.

The exterior of the container will be rinsed with distilled water.

In situ field tests for pH, temperature, and conductivity will be performed on the water immediately after sampling.

Sample containers will be placed in a cooler with "blue ice" or equivalent.

Decontamination will be performed a per Section 5.3.10.

Equipment and Field and Blanks will be collected as per Section 5.3.11.

Field parameters will be recorded, including location of sample.

The chain-of-custody and request for analysis forms will be completed.

Flow measurements, where possible, will be taken using flumes.

Samples will be transported to the laboratory or delivered to the common carrier.

5.3.6 Sediment Sampling

Sediments will be taken from drainages as a means for determining contaminant dispersion and fixing.

The middle of the channel or the active part of the drainage will be selected, avoiding material near banks where sloughing may have occurred.

Material will be collected using a stainless steel sampler or tube.

Sediment will be placed in containers until full.

Decontamination will be performed as per Section 6.3.10.

Equipment and Field and Trip Blanks will be collected as per Section 5.3.11.

Sample container will be placed in a cooler with "blue ice" or equivalent.

Sample location will be recorded on a map.

Sample collection logs designed for the activity will be completed.

The chain-of-custody and request for analysis forms shall be completed.

Samples will be delivered to the laboratory or common carrier.

6.3.7 Geophysical Surveys

The purpose of geophysical surveys is to provide information regarding shallow subsurface conditions at various sites. Surveys using Magnetometry, Ground Penetrating Radar (GPR), and Electromagnetic Conductivity (EM) may be used on a site-specific basis.

Magnetometer

Magnetometer surveys may be used to locate buried drums or tanks and are especially effective at locating large deposits of drums or other metal objects.

Prior to beginning a magnetometer survey of each separate area, a base station will be established. This base station will be established in a low, horizontal gradient. Calibrations will be made prior to any surveys and recorded on a dedicated field form. This station will be reoccupied one hour before noon and at the end of the day. Calibration readings will be noted at each time interval and recorded in the field notebook.

Any diurnal shifts will be corrected and noted on the field form. All calibration will be made according to the manufacturer's specifications.

If a major magnetic storm is noticed, the survey will be terminated. The area effected by the storm will be resurveyed when atmospheric magnetic stability is established.

Ground Penetrating Radar (GPR)

Ground Penetrating Radar (GPR) may be used to map depth,thickness and lateral variations in soil and rock layers. It may also be used to detect buried pipes, drums, caverns, and confining clay layers. The depth of penetration is site specific and may be as great as 100 feet, however, typical penetration is less than 30 feet. The GPR has been useful in locating the edges and boundaries of waste disposal trenches which have been graded and covered.

The GPR equipment will be calibrated daily according to the manufacturer's specifications. All calibration data will be recorded daily on a dedicated field form.

Electromagnetic Conductivity (EM)

EM may be used to locate contaminant plumes in shallow ground water systems.

Calibrations will be conducted prior to beginning surveys each day. If transportation of equipment occurs to various sites, calibrations will be checked prior to the surveying of each site. Calibrations will be performed according to the manufacturer's recommended specifications.

5.3.8 Soil Gas Surveys

Soil gas will be collected to help determine contamination by volatile organic compounds over broad areas. Real-time or passive methods may be used. The Petrex passive method is presented below.

A grid will be located over the area to be investigated on 100 feet centers with every line staggered 50 feet. Individual sites shall be located to the nearest one foot.

A stainless steel hand auger will be used to drill a two inch diameter hole, two feet deep.

Prior to performing routine tube placement, two baseline locations will be established (orientation survey): one for background and one for probable maximum concentrations. At each site five tubes will be placed in separate holes within a three foot diameter. After 14 days, one tube from each area will be retrieved and its collector analyzed. The process will be repeated as necessary until sufficient exposure time is determined, using Petrex, or equivalent, soil gas tube manufacturer's data (see below for data on tube placement).

The protective cap will be removed from the end of the Petrex, or equivalent, soil gas tube. The cap will be retained in a clean environment for future use. The tube shall be placed to the bottom of the hole, and then clean sand or the hole's cuttings will be used as backfill.

After the tubes have been exposed for the sufficient amount of time, as determined during the orientation survey, the tubes will be removed from the soil, wiped clean, and the clean cap placed on the end.

The chain-of-custody and request for analysis forms will be completed.

Sample tubes will be transported to the laboratory or common carrier.

5.3.9 Radiological Surveys

Radiological surveys will be performed to qualify radiological contamination at field sites and in sampled material.

The Field Instrument for the Detection of Low Energy Radiation (FIDLER) or equivalent, will be used to establish a field calibration curve.

Equipment in good working order will be used and standardized to an isolated source as per manufacturer's instructions, on a daily basis.

In order to compare results of individual instruments, and establish qualitative estimates of radioactive isotopes in the soil, field calibration curves will be established. An orientation survey will be conducted at a background area, a

probable maximum concentration area, and a probable intermediate concentration area. A soil sample will be collected at each site and analyzed using gamma ray isotopic analysis to determine the plutonium and uranium content within the sample. Results will be compared to five, one-minute readings on each FIDLER. A calibration curve will be established for each instrument using a least squares fit.

Any investigative procedure that disturbs the ground or other material shall have a preliminary FIDLER survey with periodic monitoring. The instrument will be applied to the surface to be scanned and a one-minute count conducted. Information will be recorded on a dedicated form. Drill cuttings will be scanned in a representative composite of every 10 feet. Soil, rock, and miscellaneous material will be scanned immediately before and after the sampling procedure. Water bailers will be sampled in a similar sequence.

For estimating average radiological measurements over an area, time-integrated measurements may be conducted. Square grid areas will be established and the FIDLER carried across the area, in sinuous path, at approximately two inches from the surface. Care will be exercised not to damage the delicate detector. The rate of coverage shall be 200 ft2/minute. Two-person field crews will cover an area: one person tending the instrument and one person taking notes. Care will be taken to cover the area in a sinuous manner that represents the grid area. Anomalously high zones will be noted, and measured discretely by scanning for one minute after the time-integrated survey is complete. Information will be recorded on appropriate dedicated field forms.

5.3.10 Decontamination

Decontamination will be performed on all equipment, instruments or tools to insure that cross-contamination of samples does not occur. Spent decontamination liquids will be handled appropriately (see JSA in Health and Safety Plan).

Drilling equipment will be decontaminated before boring. Three steps will be involved:

1) A primary rinse with organic-free steam will be used.

2) A scrubbing with a detergent that does not contain phosphate shall follow.

3) A final rinse with organic-free steam will be performed.

After drilling equipment has been thoroughly decontaminated, it will be covered with clean plastic sheeting for transport to the site or storage.

All tools and sampling equipment that are used in sampling and field activities, that contact potentially contaminated material, will be decontaminated. Decontamination will be performed prior to each discrete use (e.g., before collecting each water sample, or soil sample). A four-stage process, listed below, will be used:

1) Equipment will be rinsed with water to remove gross contamination.

2) A scrubbing with a detergent that does not contain phosphate will follow.

3) Deionized water will be used to rinse-off detergent

4) Cover or wrap to prevent soiling.

5.3.11. Rinsate and Field/Trip Blanks

Following the decontamination procedure, a rinsate-blank sample will be collected once a week to check for possible cross-contamination. Deionized water will be used to rinse all equipment which comes in contact with a sample. It will be collected in an appropriate container as shown in Tables 5-1. (This deionized rinse is in addition to the final deionized rinse of the contamination procedure). Rinsate blanks will be assigned a unique sample number and be subject to chain-of-custody, request for analyses, field descriptions, and other necessary measures as applies to samples.

The field and trip blanks will be prepared by collecting deionized water (same source as used for the decontamination) in an appropriate container. The blanks shall be assigned a unique number and be subject to chain-of-custody, request for analyses, field descriptions, and other necessary measures as applies to samples.

5.4 SAMPLE IDENTIFICATION

Samples shall be adequately marked for identification at the time of collection. Marking shall be on the sample container (bag, jar, bottle, etc.), on a tag or label attached to the sample container, and/or in a field log referenced to the sample. Sample identification shall include, as a minimum:

Project name and number

Unique sample number

Sampling location (e.g., boring, depth or sampling interval, and field coordinates)

Sampling date and time

Individual performing the sampling

Preservation or conditioning employed

A typical identification label for chemical analysis samples is shown in Figure 5-8.

5.5 SAMPLE FILTRATION, PRESERVATION, SHIPPING, AND STORAGE

5.5.1 Samples for Radiological Analysis

Care will be taken in handling radioactive samples. A preliminary radioactive emission survey for each sample will be made in the field using a portable radiation survey meter. Ground and surface water samples will be preserved by nitric acid (pH < 2.0) in plastic or glass containers. Soil/sediment samples will be directly placed into wide-mouth plastic containers and will not require any additives for preservation. The plastic containers will then be securely packed in cardboard boxes. Radiation data for each sample will be documented on chain-of-custody forms and accompany the samples. The samples will be shipped according to DOT regulations.

Radiological samples will be identified and packaged to comply with title 49 Parts 172-173 of the Code of Federal Regulations. This procedure provides guidance in the proper packaging and the

transportation of limited quantities, NOS radioactive materials. Field personnel will determine the need to ship samples as low-specific activity, NOS radioactive material.

Screening for shipping will be performed by the onsite laboratory

Samples - Aliquots of predetermined size will be placed in individual containers with secure closure.

Liquid Samples - Should be placed in a shipping container filled with enough absorbent material to absorb the liquid if it leaks from the sample container.

Shipping Container - A plastic or steel five-gallon bucket, or a sturdy plastic ice chest, with a lid which fits securely will be used for shipping low-specific activity materials, or DOT regulations will be met.

It is expected that samples shipped off site will meet DOT requirements for limited quantities. As such, no package labels are required.

External surfaces of shipping containers must be surveyed for removable radioactive contamination and should not exceed the following levels:

- 2,200 dpm bg /100 cm2
- 220 dpm a/100 cm2

Shipper's Declaration, as required (two copies of this form should be sent with the shipment).

- Shipper: Fill in company name and address.

- **Consignee:** Fill in company name and address for shipment.

- **Transport Details:** Delete passenger and cargo aircraft.

- **Shipment Types:** Delete nonradioactive.

- **Proper Shipping Name:** Fill in radioactive material, limited quantities, NOS.

- **Class or Division:** Fill in radioactive materials.

- **UN or ID Number:** Fill in UN-2912.

- **Quantity and Type of Packaging:** Fill in the name of symbol of radionuclide, the chemical form, physical state (solid or liquid), the number of packages of same type and content, package type, and activity. Estimate the amount of activity.

- **Packaging Instructions:** Fill in the label used and the TI. Include package dimensions.

- **Additional Handling Information:** Fill in, "This package conforms to the conditions and limitations in 49 CFR 173.425 for radioactive material, LSA NOS UN-2912."

- **Name/Title of Signatory:** Fill in name and title.

- **Place and Date:** Fill in location and present date.

- **Signature:** Shipper's signature

All samples for radioisotopic analyses will be shipped to a radiological laboratory for initial radiological screening as per Section 8.1.

5.5.2 Samples for Chemical Analysis

When it is desired to determine concentrations of dissolved inorganic constituents in the water, the samples will be filtered (e.g., 0.45-micron filter) in the field using a Millipore filtration apparatus equipped with a hand or electrical vacuum pump or pressure filtration apparatus. The filtering apparatus or equivalent will be cleaned and rinsed thoroughly with distilled water before filtering each sample. The first 100 to 150 milliliters of filtrate from each sample should be used to rinse the filter and filtration apparatus of any contaminating substances and then discarded. The filtered sample shall be transferred immediately to sample bottles containing appropriate preservatives.

Samples for chemical analysis shall be preserved and maintained as indicated in Tables 6-1 and 6-2. Samples to be shipped off site for chemical testing should be placed in ice chests containing "blue ice" or a similar pack of frozen gel, sealed within a hard container, and packed to prevent breakage during shipment. The ice chest shall be addressed, identified, and placarded as appropriate. Samples shall be taken to any designated shipper by designated personnel who will verify that all samples are accompanied by chain-of-custody records (Figure 7-1) and shipped per DOT regulations, if applicable. Transportation shall enable samples to arrive at the laboratory in time to permit testing in accordance with established sample holding times and project schedule. No samples shall be accepted by the receiving laboratory personnel unless they are properly labeled and sealed.

Sample storage in the laboratory will generally be in a refrigerated, secured area until required analyses are completed within the appropriate holding times.

5.5.3 Samples for Geotechnical Testing

Samples to be used only for geotechnical testing shall be sealed, shipped, and stored such that a representative sample is maintained. If contamination is present, then appropriate DOT procedures shall be applied.

5.6 REFERENCES

Cooper, H. H., Jr., J. D. Bredehoeft, and I. S. Papadopoulos, 1967, "Response of a Finite-Diameter Well to an Instantaneous Charge of Water," Water Resources Research, Vol. 3, No.3, pp. 263-269.

Bouwer, H. and R. C. Rice, 1976, "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells," Water Resources Research, Vol. 12, No. 6, pp. 423-428.

6.0 CHAIN-OF-CUSTODY

An overriding consideration for data resulting from laboratory analyses is the ability to demonstrate that the samples were obtained from the locations stated and that they reached the laboratory without alteration. To accomplish this evidence of collection, shipment, laboratory receipt, and laboratory custody until disposal must be documented. Documentation shall be accomplished through a chain-of-custody form that records each sample and the individuals performing the sample collection, shipment, and receipt. A sample is considered in custody if it is:

In a person's actual possession

In view, after being in physical possession

Locked away so that no one can tamper with it, after having been in physical custody

In a secured area, restricted to authorized personnel

Chain-of-custody forms (Figure 6-1) will be used by appropriate personnel in collecting and shipping all samples that change custody. The chain-of-custody procedure will be as follows:

Prior to sampling, personnel involved will receive copies of the chain-of-custody procedure. A briefing for these personnel will be held to detail the chain-of-custody procedure (as well as sampling and sample handling procedures). Briefing of personnel is the responsibility of the Subcontractor Site Manager or his/her designated representative.

The chain-of-custody record (e.g., Figure 6-1) shall be initiated in the field for every sample by the person collecting the sample. Every sample will be assigned a unique identification number that is entered on the chain-of-custody form. Samples can be grouped for shipment and use a common form. It is noted that the names of all members of the sampling team will be listed on the chain-of-custody.

If the person collecting the samples does not transport the samples to the laboratory or deliver the sample containers for shipment, the first "Relinquished By _____," "Received By _____" shall be completed in the field.

If the samples are directly transported to the laboratory, the chain-of-custody shall be kept in possession of the person delivering the samples.

The person transporting the samples to the laboratory or delivering them for shipment will sign the record form as "Relinquished By ___."

If the samples are shipped to the laboratory by commercial carrier, the chain-of-custody form shall be sealed in a watertight container, placed in the shipping container, and the shipping container sealed with custody tape prior to giving it to the carrier.

For samples shipped by commercial carrier, the waybill shall serve as an extension of the chain-of-custody record between the final field custodian and receipt in the laboratory, and therefore shall be documented.

Upon receipt in the laboratory, a designated individual shall open the shipping containers, compare the contents

with the chain-of-custody record, and sign and date the record. Any discrepancies shall be noted on the chain-of-custody form.
If discrepancies occur, the samples in question shall be segregated from normal sample storage and the field personnel immediately notified.

The chain-of-custody form is completed after sample disposal. Samples not consumed during analysis shall be kept for six months or as otherwise established.

Chain-of-custody records shall be maintained with the records for the project, becoming part of the data package.

The following documentation may supplement (but not replace) the chain-of-custody records:

- Sample label on each sample

- Photographic records (wherever practical)

- Sample collection log and request-for-analysis forms (copy accompanies the samples)

Multipart chain-of-custody forms may be used so that a copy can be returned to the individual shipping the sample after they are received at the laboratory.

7.0 LABORATORY TESTING

Laboratory testing performed for this project will be of three general types, radiological analysis, chemical analysis, and geotechnical analysis. Each type of testing is discussed in the following sections.

7.1 GENERAL LABORATORY TESTING PROCEDURES

All laboratory testing will be performed in accordance with documented and approved procedures by trained personnel using calibrated equipment (Section 5.0). EPA policies and procedures will be used. All analytical (i.e., radiological and chemical) testing will be controlled by the formal laboratory QC programs (e.g., method certification, reagent blanks, method blanks, field blanks, duplicates, check standards, internal standards, spikes, and statistical analysis of results). Test performance, any QC analyses, and results will be documented using standard forms/formats. The reduction of test data will undergo formal documented verification. If there is no certified method for an analysis in a matrix, then method certification shall be performed. Step-by-step procedures will be developed for the compound in each matrix of interest. All quality control parameters i.e., spikes, blanks, accuracy, precision, percent recovery, etc., will be evaluated. A method certification plan and resultant procedure (after development) will be documented.

All samples collected for any type of off-site laboratory analyses must go to a radiological laboratory for initial screening for radiological contamination. Such contamination shall be noted and that record shall become part of the sample's analytical record and shall accompany the sample. If the level of radioactivity exceeds acceptable levels for routine laboratory radiological standards then analyses of those samples shall be

performed by laboratories with policies and procedures for excessive radioisotopic levels.

7.1.1 Laboratory Program Flow Chart

The generation of project radiological, chemical, and geotechnical data and results will follow a standard laboratory analytical program management scheme. The laboratory analysis flow chart (Figure 7-1) outlines the management scheme which consists of five major areas:

Project initiation
Sample collection and handling
Laboratory analysis
Data verification
Report preparation

These areas are described in the following sections.

7.1.1.1 Project Initiation

Prior to initiation of laboratory testing, a planning session with the appropriate Laboratory and Project personnel will be conducted to discuss the specific aspects of the following project tasks which must be completed at this time:

Define project requirements including equipment, test parameters, sampling procedures (Section 5.3 and the site specific work plans), any QC samples, and analytical method (Sections 7.2.1, 7.3.1, and 7.4.1) selection.

Request sample containers from laboratory custodian.

Prepare sample containers with appropriate labels and preservatives (Section 5.4 and 5.5).

Provide blank chain-of-custody forms with sample containers, which will be shipped to the site.

7.1.1.2 Sample Collection and Handling

The following procedures will be implemented by field and laboratory personnel during this phase of the project:

Summarize field data collection on field sheets and initiate chain-of-custody forms (Section 5.3).

Collect samples and transport to the appropriate laboratory under suitable environmental conditions (Section 5.5) and DOT regulations.

Examine samples received at the laboratory and review and process chain-of-custody forms. If necessary, code samples with a unique number upon receipt in the laboratory.

Place samples in proper storage (Section 7.1.2.1).

Log in samples to laboratory (Section 7.1.2.1) and open the project file.

7.1.1.3 Laboratory Analysis

Review any holding times and the amount of sample available, and prioritize analyses.

Perform analyses within any holding times and according to accepted procedures (e.g., EPA; Sections 7.2.1, 7.3.1, and 7.4.1).

In conducting the analyses, perform the appropriate quality control checks (Sections 7.2.2, 7.3.2, and 7.4.2).

Record pertinent data and observations on data sheets (Section 7.5).

7.1.1.4 Data Verification

Calculate any quality control data (Section 7.3.2.6) before completing other calculations and before reporting data.

Calculate analyses results and complete data sheets; sign and date each page.

Request that another analyst or supervisor approve the notebook or laboratory data sheets by formal checking (Section 7.1.3.1).

Record data on project data summary sheets as necessary; initial and date forms.

File any instrument charts (e.g., metals) in appropriate data files; enter information required on form.

Enter any quality control data on appropriate forms and charts.

7.1.1.5 Report Preparation

Review date on project data sheets and previous similar project data, if available (Section 7.1.3.2).

Check laboratory data sheets for comments regarding sample analyses.

Review appropriate detection limits and present summarized data with appropriate significant figures and units.

Report that holding times were within specified limits. Submit test and quality control data to contractor Project Group for report preparation.

Verify submitted typed data by formal checking.

Discuss results with Project Manager prior to submittal of any affected report to Rockwell.

Report results externally.

Transmit appropriate records to the laboratory project files.

7.1.2 Laboratory Testing Program

7.1.2.1 Receipt of Samples and Storage

Upon receipt at the appropriate laboratory, a designated individual (e.g., Quality Control Coordinator) shall:

Examine all samples and determine if proper environmental conditions have been maintained during shipment. If samples have been damaged during shipment, the remaining samples shall be carefully examined to determine whether they were affected. Any samples affected shall be also considered damaged. It will be noted on the chain-of-custody record that specific samples were damaged and that the samples were removed from the testing program. Field personnel will be notified as soon as possible that samples were damaged and that they must be resampled, or the testing program changed with appropriate documentation.

Compare samples received against those listed on the chain-of- custody.

Verify that any sample holding times have not been exceeded.

Sign and date the chain-of-custody form and attach any waybill to the chain-of-custody.
Place the samples in appropriate laboratory storage.

Enter the radiological and chemical samples in a laboratory sample log-in book which contains the following information:

- Project identification number
- Sample numbers
- Type of samples
- Date received in laboratory
- Date put into storage after analysis is completed
- Date of disposal

The last two items will be added to the log when the action is taken.

Notify the Laboratory Manager and Subcontractor Site Manager of sample arrival.

Place the chain-of-custody records in the laboratory project file.

7.1.2.2 Data Summary Forms

The testing programs will, as necessary, be summarized on project data summary sheets kept in a file folder in the laboratory project files. These folders will serve as a receptacle forcompleted laboratory data sheets as analyses are finished by individual analysts.

7.1.3 Data Validation

7.1.3.1 Checking Procedure

As described previously, laboratory data reduction and interpretation calculations shall be independently checked. Following is a discussion of the method to be used for radiological and chemical testing data. At least 20 percent of all data shall be checked in this manner. If, during the checking process, errors are determined, checking will be completely (100 percent) performed for the data set (laboratory batch number).

The analyst performing the data processing shall give the data package to an analyst independent of the work. The package shall include, as appropriate, raw data, data sheets, strip charts, computer input/output, calculations, sources for input parameters such as response factors, etc.

The independent analyst (checker) shall, as applicable, review the data for:

- Appropriateness of equations used
- Correctness of numerical input
- Numerical correctness of calculations
- Correct interpretation of strip charts, etc.

All entries and calculations that the checker reviews shall be marked with a check mark. The checking process must be thorough enough to validate that the results are correct. If the checker disagrees with any part of the computations, the checker shall mark through the number with a single red line and place the revised number above it.

Any changes made by the checker shall be back-checked by the originator. If the originator agrees with the change, no action is necessary. If the originator disagrees, the originator and checker must resolve the difference so they agree with the result presented.

The checker shall sign originals and date all pages of the data package (except for groups of printout such as chromatograms).
Signing and dating indicates that the reviewer agrees with the calculations and that any changes made have been agreed to by the originator.

If the data have been processed by computer, the reviewer shall check every input entry. Agreement should be indicated by a check mark for every line. If the checker disagrees with the input, the number should be marked through with a line and the corrected number indicated above it. Corrections must be back-checked by the originator as discussed above.

If an input error is identified and the data have been processed, it will be necessary to reprocess the data. In this event, the checker shall mark the second set of input to indicate agreement with the input changes. The checker shall sign and date the computer input to indicate agreement.

Raw data that are automatically acquired and processed do not require any checking.

The reduction of geotechnical testing data will be performed in accordance with Section 8.2 of the Quality Assurance Project Plan.

The process must be satisfactorily completed for the data to be considered valid.

7.1.3.2 Laboratory Management Review

The Laboratory Manager shall review testing results prior to external distribution. The reviewer shall:

Compare analyses performed to the proposed testing record

Review results for reasonableness

Review quality control data results

Verify that required checking was properly performed

Review sample preservation and any holding time requirements

If the Laboratory Manager finds the review indicates that data meet project quality requirements, the data will be released to the Project Group as "final" information.

7.2 LABORATORY RADIOLOGICAL ANALYSIS

7.2.1 Laboratory Radiological Testing Procedures

When appropriate samples from the Rocky Flats area will be analyzed for radiological parameters using methods listed in Tables 7-1 and 7-2. These methods represent general procedures employed for this testing program. Detailed procedures describing radioanalytical techniques, instrumentation, receiving procedures, calibration practices, and sample preparation shall be on file with the laboratory.

7.2.2 Radiological Analysis Quality Control

The radiological analysis quality control will provide that the required analysis, quality control sample checks, and verification of the results are performed and that the acceptability of the results is known and verifiable.

Any deficiencies in the testing program will be identified so that proper corrective action can be taken. Details of the quality control provided shall be on file with the laboratory.

7.2.2.1 Instrument Calibration

Laboratory equipment involved in quality-related measurements will be calibrated in keeping with manufacturer's instructions and EPA protocols.

7.2.2.2 Duplicate Sample Analysis

One duplicate sample will be run for every laboratory batch. The results of these analyses will be used to determine the percent relative standard deviation (percent RSD), which will be recorded on radiological analysis quality control forms (e.g., control charts) for the parameters being tested. If the results of the percent relative standard deviation are excessive (i.e., outside the control limits) for the material analyzed and method used, the samples will be reanalyzed.

7.2.2.3 Matrix Spike Analysis

One sample out of every laboratory batch will be spiked prior to analysis with the parameters of interest to determine the percent bias. The percent bias will be recorded on radiological analysis quality control forms (e.g., control charts). If the results of the percent bias determinations fall outside appropriate values

(i.e., control limits) for the material analyzed and method used, the samples will be reanalyzed.

7.2.2.4 Method Blank Analysis

At least one method blank for each laboratory batch will be analyzed for the pertinent radiological parameters. The method blank will consist of a distilled or deionized water sample.

7.3 LABORATORY CHEMICAL ANALYSIS

7.3.1 Laboratory Chemical Testing Program

When appropriate, samples from the Rocky Flats area will be analyzed for chemical parameters using methods selected from those listed in Tables 7-1 and 7-2. Organic analysis will include the hazardous substance list parameters in Table 7-3. These methods represent analytical procedures approved by EPA, ASTM, or other regulatory agencies; and standard laboratory methods. The actual references and detailed procedures will be maintained in the laboratory for use by laboratory personnel.

7.3.2 Chemical Analysis Quality Control

7.3.2.1 Quality Determination

An initial phase in the chemical laboratory testing program for individual parameters includes the certification of the selected methods. This procedure involves the elimination or minimizing of determination errors which may be due to analyst error; or the use of inadequate equipment, reagents, solvents, or gases. The quality of these materials, even though they are AR grade or better, may vary from one source to another. The analyst must determine, through the use of reagent or solvent blanks, if these materials are free from interfering substances under the

conditions of the analysis. Other steps include the determination of a method blank and the preparation of a standard calibration curve or response, as discussed in the following sections.

7.3.2.1.1 Method Blank Analysis

After determining the individual reagent of solvent blanks, the analyst will determine the method blank to see if the cumulative blank interferes with the analysis. The method blank is analyzed by following the procedure step by step, including the addition of the reagents and solvents in the quantity required by the method. If the cumulative blank interferes with the determination, steps must be taken to eliminate or reduce the interference to a level that will permit this combination of solvents and reagents to be used. If the blank interference cannot be eliminated, its magnitude must be considered when calculating the concentration of specific constituents in the samples being analyzed.

A method blank shall be determined (Section 7.3.2.3.5) whenever analyses are made. The number of blanks to be run is determined by the method of analysis and the number of samples being analyzed at a given time. A reasonable number is one blank with each group of samples.

Results of method blank analyses will be filed with the corresponding analytical data.

7.3.2.1.2 Preparation of Standard Calibration Curve Responses

The use of spectrophotometric of GC/MS techniques requires the use of a set of standards for each parameter to be analyzed. A standard calibration curve or response (response factor) will be obtained using calibration standards prepared by dissolving the

species to be analyzed in the solvent that is to be introduced into the instrument. Standards preparation and calibration will be performed according to the applicable laboratory methods. The preparation of standards and reagents is recorded in a log book or on the sample analysis sheets, depending on the nature of the analysis. Entries into the log books or data sheets are verified according to normal laboratory quality control procedures. The results of calibrations will be filed with the laboratory project and performance records.

7.3.2.2 Inorganic Chemistry and Metals Quality Control

7.3.2.2.1 Spectrophotometer Calibration

Prior to the analysis of samples, the spectrophotometer must be initially calibrated at a minimum of three concentrations for each parameter of interest. Concentration levels of the calibration standards should be chosen to cover the linear working range of the instrument. The instrument response should be calibrated for each parameter to provide direct absorbance readout and a calibration curve of absorbance versus concentration should be prepared. Sample concentrations can then be read directly from the curve or determined mathematically.

Following the initial calibration, a daily verification using a calibration curve midpoint check standard for each parameter (Section 7.3.2.2.3) should, as a minimum, be performed. Recalibration will be required semiannually or when results of the daily verification do not confirm a curve.

7.3.2.2.2 Analysis of Duplicates

Duplicate analyses are performed to evaluate the precision of an analysis.

Results of the duplicate analyses are used to determine the relative percent difference between replicate samples. Criteria for evaluating duplicate sample results are provided in Section 7.3.2.6. A duplicate analysis should be performed for every 10 to 15 samples. Duplicate analysis results should be summarized on quality control data summary forms (e.g., Figure 7-2 and control charts).

7.3.2.2.3 Analysis of Check Standards

At least one midpoint standard or check standard for each parameter of interest will be analyzed every day samples are tested. Analysis of these standards is necessary to verify the calibration curves being utilized. Standards and calibration curves may vary from day to day because of slight differences in reagents, instruments, or laboratory techniques. Absorbance values for check standards will be recorded on the instrument calibration log or sample analysis sheets. Check standard analysis results should be summarized on quality control summary sheets (Figure 7-2).

7.3.2.2.4 Analysis of Matrix Spike Samples

To evaluate the effect of sample matrix on analytical methodology, a separate sample aliquot should be spiked with the analyze of interest and analyzed with every laboratory batch. The percent recovery for the respective compound will then be calculated. If the percent recovery falls outside established quality control limits (Section 7.3.2.6), the data should be evaluated and the sample reanalyzed. Spiked sample results should be summarized on quality control data summary sheets (e.g., Figure 7-2 and control charts).

7.3.2.3 Organics Analysis Quality Control - GC/MS

The laboratory will implement a GC/MS quality control testing program for organics consistent with EPA specified requirements. The program will include:

- GC/MS mass calibration and tuning
- GC system calibration
- Surrogate standard performance evaluation
- Internal standard performance evaluation

Method and field blank analysis
Duplicate sample analysis

7.3.2.3.1 Tuning and GC/MS Calibration

Prior to initiating data collection, it is necessary to establish that a given GC/MS meets the standard mass spectral abundance criteria. This is accomplished through the analysis of 4-bromofluorobenzene (BFB) for volatile compounds and decafluorotriphenylphosphine (DFTPP) for base neutral acid extractable compounds.

BFB (4-bromofluorobenzene)

Each GC/MS system used for the analysis of volatile compounds will be tuned to meet the BFB abundance criteria tabulated in the applicable test method from Tables 7-1 and 7-2. The criteria conformance should be demonstrated daily.

DFTPP (decafluorotriphenylphosphine)

Each GC/MS system used for the analysis of base neutral and acid extractable compounds will be tuned daily to meet the DFTPP abundance criteria tabulated in the applicable test method from Tables 7-1 and 7-2. DFTPP may be analyzed separately or as part of the calibration standard.

Analysts will complete a GC/MS tuning and mass calibration form or provide a copy of the instrument printout each time an analytical system is tuned.

7.3.2.3.2 GC/MS System Calibration

Prior to the analysis of samples and after tuning criteria have been met, the GC/MS system will be initially calibrated using the

internal standard calibration procedure. The system will be calibrated at a minimum of five concentrations for each parameter of interest. Concentration levels of the calibration standards should be chosen to cover the linear working range of the system.

Response factors, for each parameter at each concentration level, will be calculated from concentrations and chromatogram areas determined for the parameters and their associated internal standards (Section 7.3.2.3.4). If the response factors are constant over the working range, average response factors for each parameter will be used to calculate sample concentrations.

When sample responses exceed the highest calibrated concentration level, the sample will be diluted to fall within the linear range and reanalyzed.

Following the initial calibration, a daily verification of the average response factors should be performed. If the response for any parameter varies from the calibrated response by more than 20 percent, recalibration must be performed for that compound.

7.3.2.3.3 Surrogate Standard Performance Evaluation

Surrogate standards are defined as priority pollutant compounds used to monitor the percent recovery efficiencies of the analytical procedures on a sample-by-sample basis.

Volatile Organics Analysis

Standards, method blanks, and volatile organic samples will be spiked prior to purging with the following surrogate standards:

4-bromofluorobenzene
1,2-dichloroethane-d4
Toluene-d8.

Other EPA-suggested surrogates may be added or substituted as necessary.

The surrogate standard response in each sample will be tabulated on organic analysis quality control forms to monitor the accuracy of the analysis and to evaluate the data. Samples exhibiting surrogate standards responses outside acceptable limits (Section 7.3.2.6) will be reanalyzed.

Base Neutral and Acid Extractables Analysis

Method blanks and samples will be spiked prior to extraction and analysis with the following surrogate standards:

2-Flurorbiphenyl
2-Flurophenol
Nitrobenzene-d5
Phenol-d5
Terphenyl-d14
2,4,6-tribromophenol

The surrogate standards will also be incorporated into the calibration standards to calibrate surrogate response. Other EPA-suggested surrogates may be added or substituted as necessary.

The surrogate standard concentrations present in the samples and method blanks will be quantified to determine percent recoveries and the percent recovery data will be entered on organic analysis quality control forms. If the calculated surrogate standard

percent recoveries exceed acceptable limits (Section 8.3.2.6), an additional aliquot of the sample will be extracted and analyzed

7.3.2.3.4 Internal Standard Performance Evaluation

Internal standards are defined as priority pollutant compounds used to monitor instrumental performance and quantify target compounds. The internal standards will be used to confirm the integrity of the instrumental analysis should the percent recovery values for the surrogate standards indicate a problem with the analytical method.

Volatile Organics Analysis

Standards, method blanks, and volatile organic samples will be spiked prior to purging with the following internal standards:

Bromochloromethane
Chlorobenzene-d5
1,4-difluorobenzene.

Other EPA-suggested internal standards may be added or substituted as necessary.

Base Neutral and Acid Extractables Analysis

Standards, method blanks, and samples will be spiked prior to analysis with the following internal standards:

Acenaphthene-d10
Chrysene-d12
1,4-dichlorobenzene-d4
Naphthalene-d8
Perylene-d12
Phenanthrene-d10

Other EPA-suggested internal standards may be added or substituted as necessary.

7.3.2.3.5 Method Blank Analysis

At least one method blank for each group of samples analyzed will be extracted and analyzed for volatile organics and acid and base neutral extractables.

Volatile organics analysis requires a method blank consisting of organic-free water spiked with the appropriate surrogate standards. Acid and base neutral extractables require a method blank consisting of distilled water spiked with the appropriate surrogate standards.

Results of method blank analyses will be filed with the corresponding sample analytical data.

7.3.2.3.6 Duplicate Sample Analysis

One sample for each laboratory batch will be purged or extracted and analyzed in duplicate to evaluate the precision of the analytical procedure. The relative percent difference will be calculated from the duplicate analyses and reported on organic analysis quality control forms (e.g., Figure 7-3 and control charts) for the particular compounds of interest. Should the relative percent difference be excessive for the material analyzed and method used (Section 7.3.2.5), the other quality control parameters will be evaluated to determine whether the duplicate sample needs to be reanalyzed or whether the entire set of samples requires reanalysis.

7.3.2.3.7 Matrix Spike Analysis

Matrix spike analyses will be performed on for one of every laboratory batch samples analyzed. Matrix spike analyses will be performed in duplicate in accordance with EPA analytical procedures. A separate aliquot of the sample is spiked with the appropriate pollutant compounds prior to purging or extracting the sample. The percent recoveries for the compounds of interest will then be calculated and reported on organic analysis quality control forms (e.g., Figure 8-3 and control charts). Should the percent recovery values fall outside appropriate values for the material analyzed and method used (Section 7.3.2.6), the other quality control parameters will be evaluated to determine whether an error in spiking occurred or whether the entire set of samples requires reanalysis.

7.3.2.4 Organics Analysis Quality Control - QC

The gas chromatography (GC) quality control program will include the following procedures:

- GC calibration
- Method blank analysis
- Duplicate sample analysis
- Matrix spike analysis

7.3.2.4.1 GC Calibration

Initial calibration of the GC will be performed using the external standard calibration procedure. The system will be calibrated at a minimum of three concentrations for each parameter of interest. Concentration levels of the calibration standards should be chosen to cover the linear working range of the system. Response factors, for each parameter at each concentration level, will be calculated from concentrations and

chromatogram areas determined for the parameters and their associated internal standards. If the response factors are constant over the working range, average response factors for each parameter will be used to calculate concentrations. When sample responses exceed the highest calibrated concentration level, the sample will be diluted to fall within the linear range and reanalyzed.

Following the initial calibration, a daily verification of the average response factors should be performed. If the response for any parameter varies from the calibrated response by more then +/-15 percent, recalibration must be performed for that compound.

7.3.2.4.2 Method Blank Analysis

At least one method blank will be extracted with each laboratory batch of samples analyzed to provide a means of determining that the solvents, reagents, extraction equipment, and the GC are free of contaminants.

A method blank will consist of distilled water extracted according to the appropriate analytical method. Any background contamination present in the blank will be quantitated and subtracted from the sample results. If background contamination is excessive, the source of contamination will be eliminated and the samples will be reextracted and analyzed.

7.3.2.4.3 Duplicate Sample Analysis

One duplicate sample extraction and analysis will be run every week. The results of these analyses will be used to determine the relative percent differences, which will be recorded on organic analysis quality control forms (e.g., Figure 7-3 and control charts) for the compounds being tested. If the results of the relative percent difference determinations are excessive

for the material analyzed and method used (Section 7.3.2.6), the samples will be reanalyzed.

7.3.2.4.4 Matrix Spike Analysis

An aliquot of one sample out of every laboratory batch will be spiked to extraction with the compounds of interest to determine the method percent recoveries for the sample matrix. Matrix spike analyses will be performed in duplicate in accordance with U.S. EPA analytical procedures. The percent recoveries will be recorded on organic analysis quality control forms (e.g., Figure 7-3 and control charts). If the results of the percent recovery determinations fall outside appropriate values for the material analyzed and method used (Section 7.3.2.6), the samples will be reextracted and analyzed with a sample spike to redetermine the compound percent recoveries.

7.3.2.5 General Chemical Laboratory Controls

In addition to instrument calibration and the analysis of quality control samples, the following controls shall be implemented:

Reagents and solvents shall be of certified composition.

Reagent storage environment and duration will meet EPA guidelines.

Laboratory equipment such as balances shall be regularly calibrated (Section 4.0).

Volumetric measurements shall be made with certified glassware.

Data reduction computations shall be independently checked in accordance with Section 7.1.3.1.

Qualified personnel shall be used for laboratory analyses.

Holding times and sample storage provisions shall conform to guidelines given in Tables 5-1 and 5-2.

7.3.2.6 Statistical Evaluations of Analytical Chemical Results

As part of the analytical quality control program, the laboratory will apply appropriate precision and accuracy criteria for each parameter that is analyzed. When the analysis of a sample set is completed, the quality control data generated are reviewed and evaluated to validate the data set. The review is based on the following criteria:

Reagent/Method Blank Evaluation - The reagent and/or method blank results are evaluated for high readings characteristic of background contamination. If high blank values are observed, laboratory glassware and reagents should be checked for contamination and the analysis of samples halted until the system can be brought under control. A high background is defined as a background value sufficient to result in a difference in the sample values, if not corrected, greater than or equal to the smallest significant digit known to be true. A method blank should contain no greater than two times the parameter detection limit for most parameters.

Field, Trip and Rinsate Blank Evaluation - Field and rinsate blank results are evaluated for high readings similar to the reagent and/or method blanks described above. If high blank readings are encountered (i.e., a value sufficient to result in a difference in the sample values, if not corrected, greater than or equal to the smallest significant digit known to be true), the procedure for sample collection, shipment, and laboratory analysis should

be reviewed. If both the reagent and/or method blanks or trip blanks exhibit significant background contamination, the source of contamination is probably within the laboratory. Ambient air in the laboratory and reagents should be checked as possible sources of contamination. High field or trip blank readings may also be due to contaminated sample bottles or cross contamination due to sample leakage and poorly sealed sample containers.

Standard Calibration Curve and Response Factor Evaluation - The calibration curve or midpoint calibration standard (check standard) is evaluated daily to determine curve linearity through its full range, and that sample values are within the range defined by the low and high standards. If the curve is not linear, sample values must be corrected for nonlinearity by deriving sample concentrations from a graph or by using an appropriate algorithm to fit a nonlinear curve to the standards. In addition, if average response factors are used to calculate sample concentrations, these factors will be verified on a daily basis. Verification of calibration curves and response factors is accomplished when the evaluated response for any parameter varies from the calibrated response by less than ranges given in the applicable test methods listed in Tables 7-1 and 7-2 (generally 10 to 20 percent). Instrument calibration will be in accordance with U.S. EPA and other referenced analytical procedures.

Duplicate Sample Evaluation - Duplicate sample analysis is used to determine the precision of the analytical method for the sample matrix. the duplicate results are used to calculate the precision as defined by the relative percent difference (RPD). The precision value, RPD, should be plotted on control charts for each parameter of interest. If the precision value exceeds the warning limit for the

given parameter, the appropriate laboratory personnel are notified. If the precision value exceeds the control limit, the sample set must be reanalyzed for the parameter in question. Precision limits will be updated periodically following review of data. Precision evaluations will be in accordance with EPA and other referenced analytical procedures.

Check Standard Evaluation - The results of check standard analysis are compared with the true values and the percent recovery of the check standard is calculated. If correction is required (excessive or inadequate percent recovery), the check standard should be reanalyzed to demonstrate that the corrective action has been successful.

Matrix Spike Evaluation - The observed recovery of the spike versus the theoretical spike recovery is used to calculate accuracy as defined by the percent recovery. The accuracy value, the percent recovery, should be plotted on control charts for each parameter of interest. If the accuracy value exceeds the warning limit for the given parameter, the appropriate laboratory personnel are notified. If the accuracy value exceeds the control limit, the sample set must be reanalyzed for the parameter in question. Matrix spike evaluations will be in accordance with EPA and other referenced analytical procedures.

Surrogate Standard Evaluation - The results of surrogate standard determinations are compared with the true values spiked into the sample matrix prior to purging or extraction and analysis, and the percent recoveries of the surrogate standards are determined. If the accuracy value, percent recovery, exceeds acceptable limits, the sample should be reanalyzed. Surrogate standard evaluations will be in accordance with U.S. EPA analytical procedures.

As part of the review outlined above, precision and accuracy quality control charts should be established for all major analytical parameters. A minimum of 10 measurements of precision and accuracy are required before control limits can be established. In general, control limits of three standard deviations shall be utilized. Once established, control limits will be updated as additional precision and accuracy data become available. Samples with relative percent differences or percent recoveries exceeding their respective control limits will be reanalyzed.

7.4 LABORATORY GEOTECHNICAL ANALYSIS

7.4.1 Laboratory Geotechnical Testing Program

Applicable ASTM or EPA procedures shall be utilized for geotechnical laboratory testing. If an ASTM or EPA procedures is not applicable or available, a testing procedure will be developed in accordance within the guidelines of the contractor's Quality Assurance program.

The gradation of some sediment samples will be analyzed to characterize these materials. The particle size distribution will define if the sediment samples are well graded, fairly well graded, fairly uniform, uniform, or gap graded.

Variances to established testing methods will be documented using the procedures given in Chapter 8.3 of this plan.

7.4.2 Geotechnical Analysis Quality Control

Statistical controls are normally not applicable to geotechnical testing. The following quality controls are routinely

implemented for geotechnical testing, and will be employed for this project:

Proper storage of samples

Use of qualified technicians

Use of calibrated equipment (as discussed in Section 5.0) traceable to NBS or equivalent standards

Formal independent checking of computation and reduction of laboratory data and results (Section 9.2 of this plan)

Use of standardized test procedures

The Laboratory Manager is responsible for the implementation of these controls on a continuing basis.

7.5 DOCUMENTATION

Laboratory testing programs will utilize prepared forms to systematically and uniformly document administrative and technical information. These forms shall be available prior to initiating the testing programs.

Test data forms shall be completed during the testing and subsequent data reduction. All requested information shall be addressed. This information shall include, as appropriate:

Project name and number

Identification of test personnel

Testing date

Identification of calibrated equipment used (test equipment list giving equipment name and unique identification number)

Identification and description of sample(s) tested

Test data and any subsequent data reduction

Test results in the form of tables and curves

Unusual conditions encountered

If not applicable, requested information should be designated as such. Sample test data forms are presented in Figures 7-4 through 7-6.

The collection and analysis of quality control data will be documented on test data forms and quality control data forms and charts. This data should include the evaluations of reagent/method blanks, field blanks, rinsate blanks, duplicate samples, matrix spikes, and surrogate standards. It will be summarized as necessary (e.g., in tables) and reported with the test data.

Laboratory administrative forms, test data, quality control data, computer printouts, and checkprints shall be organized and maintained by the cognizant laboratory in the laboratory files (Section 8.4.3).

8.0 DATA MANAGEMENT

Numerical analysis and environmental modeling will be subject to strict controls. Any changes to final analysis, assessments, and modeling will be subject to the same level of control used for the originals.

8.1 CONTROL PROCEDURES FOR ANALYSIS AND DESIGN

Analysis, design, and modeling activities shall be performed in a planned and controlled manner. Performance responsibility rests with the CEARP Program Manager. Prior to initiating the activities, the CEARP Program Manager and CEARP Field Manager shall discuss the scope of the work, contractual and regulatory requirements, and applicable quality assurance/quality control procedures with assigned personnel.

To provide evidence of satisfactory work performance and the basis for information analyses, designs, modeling, and their results shall be completely documented. Documentation may include calculations, computer programs, logs, drawings, tables, and other applicable documents.

8.1.1 Calculations

Calculations shall be legible and in a form suitable for reproduction, filing, and retrieval. Documentation shall be sufficient to permit a technically qualified individual to review and understand the calculations and verify the results.

Calculations shall be performed on standard calculation paper whenever possible. All calculation pages shall be individually identified with the exception of large computer output. Calculation paper shall provide spaces for the originator's name and date of work, the checker's name and date, calculation

subject, project name and number, and page number. All of this information shall be completed for each page. For extra pages, such as large graphs, this information shall also be included.

Calculations should, as appropriate, include a statement of calculation intent; description of methodology used; assumptions and their justification; input data and equation references, numerical calculations including units; and results. Input data may include:

Regulatory requirements

Performance and operational requirements under various conditions

Material, geological, environmental, radiological, and geotechnical requirements

Results of field and laboratory testing or calculations

Information obtained from external personnel or literature and site data surveys

Computer printout that becomes an integral part of the calculations shall be referenced in the calculations by run number or other unique means of identification.

At the end of calculations, the results should be summarized.

8.1.2 Computer Programs

Computer programs used shall be completely documented and verified. Computer output shall be dated and clearly identified as to contents. Large sets of output shall be labeled with

project name and number, program used, analysis title, and the user's name.

8.1.3 Logs, Drawings, and Tables

The results of analysis, assessment, and modeling activities may be presented in logs, drawings, and tables of various forms. The format of logs and tables shall be governed by the information to be presented. Drawings shall be uniquely identified by drawing or figure number and appropriate title. Standardized symbols or nationally accepted, drafting standards shall be used. References to other drawings and sources of information shall be provided, as necessary.

Drawings shall be signed and dated by the draftsperson performing the work and the responsible member who has checked the drawing (Section 8.2.3).

Revisions shall be noted on the drawing original with a revision number and a brief note describing each revision. The note shall be signed and dated by the draftsperson performing the work and the responsible member of the Project Group who has checked the revision.

8.2 VERIFICATION

Calculations, computer program input, logs, drawings, and tables shall be formally checked using the standard process outlined in the following sections.

8.2.1 Calculations

Verification of calculations shall be performed by an individual(s) other than the persons who performed the original work, or specified the method or input parameters to be used.

The individual(s) selected shall have technical expertise in the calculation subject.

It is emphasized that a numerical check is not sufficient. The checker is responsible for every item of information on every sheet--including the completion of the title block and page numbers.

To properly check calculations:

The originator supplies the designated checker with a machine copy of the calculations. Originals should not leave the originator's possession until they are ready for final checker signing.

The checker marks the calculation copy with a yellow marker for all items he approves.

If the checker disagrees, for any reason, the checker crosses through the item with a red marker and writes the recommended correction or comment above it.

The checker initials and dates all pages of the checkprints.

The checker returns the checkprints to the originator who, in turn, reviews all recommended changes. If a disagreement exists, the originator adds comments to the checkprints using a third color and then confers with the checker until all differences are resolved.

The originator corrects, or "scrubs," the calculation originals so they agree with the checkprints. A one-to-one correspondence between the originals and checkprints must exist.

The originator gives the originals and checkprints to the checker who compares them to verify agreed-to corrections have been made.

When the checker is satisfied, he signs and dates the originals.

8.2.2 Computer Program Input

Computer input shall be formally checked using the standard process outlined in Section 9.2.1 above. A single exception to this process is that the checking may be performed on the input originals. The verification shall include a conceptual review of the program itself based on the problem being solved, a review of the computer model employed, a check that the program has been verified, and a formal check of the input data.

8.2.3 Drawings

Drawings shall be checked like calculations (Section 9.2.1) using yellow and red markers. Consecutive checkprints of the same drawing shall be marked CP1, CP2, etc., to show progression of the checking process.
If a drawing is revised, the entire checking process shall be repeated. A new checkprint shall be prepared. Under no circumstances shall revisions be made without the formal checking procedure.

8.2.4 Logs and Tables

Final subsurface logs shall be verified by the responsible member. The verification shall provide that changes from the original field representative's logs to the final log sheets are consistent with the results of other investigations. The final log sheets shall be checked in the same manner as all

calculations or drawings, with the checker signing and dating all checkprints.

In addition, all final tables presenting information, data, or the results of analyses shall be checked using the standard verification process (Section 9.2.1). Consecutive checkprints of the same table shall be marked CP1, CP2, etc., to show progression of the checking process.

8.3 VARIANCE AND NONCONFORMANCE

It is imperative that the status of work items be up-to-date. A status system includes:

Variance documentation and evaluation (Section 8.3.1)

Nonconformance identification, documentation, and reporting (Section 8.3.2)

8.3.1 Variance Control

Variances are changes from original documents, procedures, and specifications and in practice must be expected. Change does not imply a nonconformance to the work, but simply means that original plans must be altered because of information or events that occur during the work. All variances may be approved verbally by the CEARP Program Manager prior to implementation. All new procedures are written and approved within seven (7) days.

Variances shall be documented, logged, and evaluated. It is necessary to manage change so that the actual course of the work, not the original plan, can be demonstrated and justified. Changes, therefore, will be documented so that the actual course

of work is known and the effect of the change on the course of work can be evaluated.

It is the responsibility of project personnel to appropriately record the variance [e.g., Variance Log (Figure 8-1) and Field Activity Daily Log (Figure 5-1)] and to make the documentation available as appropriate to project or laboratory management. The effect of the change on the project will then be evaluated by the project or laboratory management, quality assurance personnel, and/or subcontractor management. The change should be evaluated prior to implementation. Following the evaluation, notification of the change should be made to appropriate personnel and affected documents revised as necessary to reflect the work as actually performed.

8.3.2 Nonconformance and Remedial Action

Nonconforming items and activities are those which are deficient in meeting project requirements, procurement document criteria, or approved work procedures, such that the quality of an item or activity is unacceptable or indeterminate. Nonconformances may be detected and identified by differing individuals:

Project Staff - During the performance of field investigation and testing, supervision of subcontractors, and preparation and verification of numerical analyses and design.

Laboratory Staff - During the preparation for and performance of laboratory testing, calibration of equipment, and quality control activities.

Quality Assurance Personnel - During the performance of audits.

Each nonconformance will be documented by the personnel identifying or originating it and recorded on a nonconformance log. For this purpose, a standard form [e.g., Nonconformance Report (Figure 8-2)], results of laboratory analysis quality control tests, audit report, internal memorandum, or letter will be used as appropriate. Documentation will, when necessary, include the following:

Identification of the individual(s) identifying or originating the nonconformance

Description of the nonconformance, including a unique nonconformance number

Method(s) for correcting the nonconformance (corrective action) or reason for no corrective action

Schedule for completing corrective action, if necessary

Any required approval signatures

The CEARP Program Manager will sign and review all nonconformances. The Manager will determine the magnitude of the non-conforming situation and report any significant impacts, and indicate necessary corrective action, if any.

Any significant recurring nonconformance should be evaluated by project, laboratory, and/or quality assurance personnel to determine its cause and appropriate changes instituted in project requirements and procedures to prevent future recurrence. When such an evaluation is performed, the results will be documented.

8.4 RECORDS ADMINISTRATION

This project will require the administration of onsite, laboratory, and office central project record files. Onsite files will be located at a field office; laboratory files shall be retained by the laboratory; and office central project files shall be located in the contractor's primary office. The records systems shall provide adequate control and retention for project-related information. Record control shall include receipt from external sources, transmittal, transfer to storage, and indication of record status. Retention shall include receipt at storage areas, indexing and filing, storage and maintenance, and retrieval. Records shall be stored in such a manner to prevent their degradation due to heat, moisture, or other effects for the life of the facility.

8.4.1 Office Central Project Files

8.4.1.1 Record Control

The control of records provides for the flow of internal and external information. Incoming project-related materials in the form of correspondence, sketches, logs, authorizations, or other information will be routed to the CEARP Program Manager after the original is marked with the date received and the project number by a member of the Project Staff or a person assigned this duty. The CEARP Program Manager will initial and then determine which personnel should review the incoming materials and route the materials accordingly.

As soon as practical, incoming correspondence originals will be placed in the project central file. If the correspondence is required by the project personnel for reference, a copy should be made rather than holding the original. Correspondence which is addressed to the Project Staff, but is of importance to the

project Quality Assurance Program, will be routed to the Quality Assurance Officer.

Outgoing project correspondence and reports will be read by the CEARP Program Manager or the Manager's designee prior to release. The office copy of project correspondence should bear routing information and be routed to Quality Assurance personnel, if judged appropriate by the Manager.

Following receipt of information from external sources, completion of the field phases of the project, completion of analyses, and issuance of reports or other transmittals; associated records shall be submitted to the office central project files. This shall include records generated by the contractor's subcontractors. Records shall be legible and easily identifiable. In addition, field records and records transmitted between contractor and subcontractor offices shall be adequately protected from damage and loss during transfer (e.g., hand carrying or making copies prior to shipment).

Field records and checkprints; laboratory data summaries; numerical calculations and checkprints; reports and other data transmittals; copies of proposals, purchase orders for project services, and contracts; correspondence including incoming and outgoing letters, memorandums, and telephone records; photographs; reference material; and drawing checkprints shall be transferred to the project central file. Documentation and verification of computer programs shall be submitted to the project central file (project-specific programs) and the computer area (generic programs) for storage.

Records submitted to the project central file should be bound, placed in folders or binders, or otherwise secured for filing. These records shall be marked sufficiently with the project name

and number, title, and other uniquely identifying information such that prompt retrieval is possible.

8.4.1.2 Record Status

All individuals on the Project Staff shall be responsible for reporting obsolete or superseded project-related information to the CEARP Program Manager or Subcontractor Site Manager. Notification of personnel of status changes in quality assurance procedures shall be the responsibility of the CEARP Program Manager.

In general, outdated drawings and other documents shall be marked "void," however, the CEARP Program Manager may request the copies be destroyed. It is recommended that one copy of void documents be maintained for the project files with the reasons for and date of voiding clearly indicated.

To denote calculations, drawings, and other material which have not been formally checked, are based on information which has not been checked, or do not contribute to final project information; these documents shall be marked "preliminary."

8.4.1.3 Record Retention

Information associated with the project shall be retained in the subcontractor's office central project files.

These files will include the following:

Project central file (project material except drawing originals, records related to laboratory analysis (Section 8.4.3), and quality assurance records)
Original drawing file

Quality assurance file

Generic computer program documentation and verification file

Project records shall be received at the various storage areas by designated personnel. Designated personnel shall check that incoming records have proper identification for filing, are legible, and are in suitable condition for storage. Indexing and filing of records shall be performed only by designated personnel.

For the project central file, the individual file folders shall be divided into appropriate categories based on content, and numbered and filed sequentially within each category. Table 9-1 lists the various project central file categories, their respective letter designations, and examples of the contents for each category.

A numbered index for the project central file shall be prepared and maintained. The index shall list the individual file folders and identify the records therein to facilitate locating the records. The index shall be kept in a separate folder at the front of the project file. If appropriate, information on project material not stored in the project central file should be included with the index.

For the original drawing and quality assurance files, all material shall be filed by project number. Computer area files of generic program documentation and verification shall be organized by program name.

Record storage in the central files shall utilize facilities that provide a suitable environment to minimize deterioration or damage, and that prevent loss. The facilities should have controlled access and shall provide protection from excess

moisture and temperature extremes. Records shall be secured in binders, placed in folders or envelopes, or otherwise secured for storage in containers (e.g., steel file cabinets).

Storage systems shall provide for the prompt retrieval of information for reference of use outside the storage areas. For the project central file, a sign-out system shall be maintained so that a record of files removed is available.

8.4.2 Laboratory Files

The laboratories will maintain records management systems for documents pertinent to testing performance. These systems will provide record control and retention similar to that outlined in Sections 9.4.1.1 through 9.4.1.3 for the office central project files (i.e., submittal to the file, indexing and filing by designated personnel, filing by categories or subjects, storage and maintenance to minimize damage and prevent loss, and record retrieval). Laboratory files may be sent to the office central project files at the completion of the project or at an interim time as requested.

9.0 QUALITY ASSURANCE AUDITS

To verify compliance with specific project Quality Assurance Project requirements Quality Assurance personnel shall perform planned and documented audits of project activities. These audits shall consist, as appropriate, of an evaluation of quality assurance/quality control procedures and the effectiveness of their implementation, an evaluation of work areas and activities, and a review of project documentation. Audits shall be performed in accordance with written checklists by trained personnel and, as appropriate, technical specialists. Audit results shall be formally documented and sent to project management.

Audits may include, but not be limited to, the following areas:

- Subcontractor capabilities and performance
- Field operations and records
- Laboratory testing and records
- Equipment calibration and records
- Identification and control of samples
- Numerical analyses, risk assessment, and environmental modeling
- Computer program documentation, and verification
- Transmittal of information
- Record control and retention

9.1 PERFORMANCE

An individual audit plan shall be developed to provide a bases for each audit. This plan shall identify the audit scope, activities to be audited, audit personnel, any applicable documents, and the schedule. The plan shall be consistent with the project scope of work, schedule, and requirements. The Lead Auditor shall direct all audits.

A field operations audit will involve an on-site visit by a Quality Assurance auditor. Items to be examined may, as appropriate, include the availability and implementation of approved work procedures; calibration and operation of equipment; labeling, packaging, storage and shipping of samples obtained; site investigation and testing performance, documentation, and checking; subcontractor performance; and nonconformance documentation.

A report audit may examine, as appropriate, the documentation and verification of field and laboratory data and results; performance, documentation, and verification of analyses; documentation and verification of computer programs; preparation and verification of drawings, logs, and tables; content, consistency, and conclusions of the report; compliance with regulatory, and project requirements; and maintenance and filing of project records.

The records of field operations shall be reviewed to verify that field-related activities were performed in accordance with appropriate project procedures. Items reviewed shall include, but not be limited to, the calibration and/or maintenance records of field equipment; daily field activity logs; photographs; and data, logs and checkprints resulting from the field operations.

The auditing of laboratory testing records shall include, but not be limited to, the originals and checkprints of laboratory data sheets, originals and checkprints of data presentations prepared by the Laboratory Staffs, and laboratory test scheduling records for the project.

Auditing of analyses shall include a complete review of calculations, computer input, sketches, charts, tables, and their associated checkprints that were prepared by the Project Group.

These items shall be reviewed to verify conformance to project requirements.

The results from audits fall into two broad categories: findings and observations. Findings are a deviation or non-compliance with established Quality Assurance policies and procedures. A finding must be addressed and corrected to meet the Quality Assurance objectives as determined by the Auditor. Observations are suggestions that project personnel should consider. Generally, suggestions are the result of a situation that, while not directly defying Quality Assurance objectives, runs counter to the quality aspects and objectives of the project.

During an audit and upon its completion, the auditors will discuss the findings with the individuals audited and suggest corrective actions to be initiated. Minor administrative findings which can be resolved to the satisfaction of the auditors during an audit are not required to be noted as "findings" requiring corrective action. All findings that are not resolved during the course of the audit and findings affecting the overall quality of the project, regardless of when they are resolved, shall be noted on the audit checklists.

9.2 REPORTS TO MANAGEMENT/PROJECT RESPONSE/CLOSURE

Following completion of an audit, the auditors shall prepare and submit a post audit report to the CEARP Program Manager, affected Laboratory Manager, Subcontractor Site Manager, and Quality Assurance. This report shall serve to notify management of audit results. The report may also be sent to individuals contacted during the audit and the management of any affected subcontractor.

The report shall be prepared as soon as possible (within 30 days) after the audit and contain, as appropriate:

Date(s) of the audit

Identification of audit participants

Identification of activities audited

Audit results

Description of findings requiring corrective action and, if possible, the means for correction

Description of observations and means for correction

Due date for completion of corrective actions and/or audit response

Means for audit response (in writing)

If corrective action is required in the post audit report, the corrective action shall be undertaken and completed on schedule unless sufficient evidence can be provided through management receiving the post audit report to prove that the action is unnecessary. If required, the Quality Assurance Officer is empowered to stop work on the project pending resolution.

The individuals audited shall respond in writing to the audit report. The response shall clearly state the corrective action taken or planned. If all corrective actions have not been completed prior to issuance of the audit response, a scheduled date for completion shall be provided.

Completion of corrective action of findings shall be verified by the auditors through written communication, reaudit, or other appropriate means.

After acceptance and verification of corrective actions, an audit closure shall be issued by the auditors to the same individuals receiving the post audit report.

QUALITY ASSURANCE PROJECT PLAN

TABLES

TABLE 4 1

LABORATORY AND FIELD EQUIPMENT CALIBRATION PROCEDURES

INSTRUMENT/EQUIPMENT	MANUFACTURER AND MODEL[a]	CALIBRATION REFERENCE	CALIBRATION FREQUENCY
Chemical Inorganic Analysis			
Atomic Absorption Spectrophotometer	Perkin-Elmer Model 5000	1,2,3	Daily[b]
Inductively Coupled Argon Plasma Emission Spectrometer	Jarrell-Ash 9000 Instrumentation Laboratory Model Plasma - 200	2,5	Daily
UV/VIS Spectrophotometer	Perkin-Elmer Model Lambda 3 Beckman Model DU-50	1,2,3	Daily
Specific Ion Meter/ Microprocessor	Orion 901 Ionalyzer	1	Daily
Analytical Balances	Sartorius Model 2003 MPI Mettler Models H33 and H10	4	3 Months
Top-Loading Balances	Mettler Models 2300 and PC 4400	4	3 Months
Thermometers	Varies	4	12 Months
pH/mV Meter	Fisher Model 230A Orion 407A Meter	1	Daily
Conductivity Meter	Fisher Model 152 YSI Model 32	1	Daily
Ion Chromatograph	Millipore/Waters	8	Daily
Chemical Organic Analysis			
Gas Chromatograph/ Mass Spectrometer	Hewlett-Packard Model 5985B Finnigan Models 4530B, 4000, 4510B, OWA1020, and OWA20B	7	Daily

[a]This specific equipment, or its equivalent, will be used

[b]Each day samples are analyzed.

TABLE 4 1

LABORATORY AND FIELD EQUIPMENT CALIBRATION PROCEDURES
(Continued)

INSTRUMENT/EQUIPMENT	MANUFACTURER AND MODEL[a]	CALIBRATION REFERENCE	CALIBRATION FREQUENCY
Chemical Organic Analysis (Cont)			
Gas Chromatograph	Perkin-Elmer Sigma 1 and 300 Hewlett-Packard Model 5890 Varian Models 3700, 6000 and 6500	7	Daily
Flame Ionization Detector	Apalabs OVA Model 108	8	Daily
Photoionization Detector	HNU Systems, Inc Model PI-101	8	Daily
Total Organic Carbon Analyzer	Oceanographics International Model 524 or 700	3	Daily
Total Organic Halide Analyzer	Oceanographics International Model 610	2	Daily
Physical Analysis			
Water Level Indicator	Solinst	4	3 Months
X-ray Diffractometer	Rigaku Giegerflex	9	Daily
Proving Ring	Wykeham-Farrance	4	12 Months
Dial Gauge	Soil Test	4	12 Months
Sieve	Soil Test	4	6 Months

[a]This specific equipment, or its equivalent, will be used

[b]Each day samples are analyzed.

TABLE 4-1

LABORATORY AND FIELD EQUIPMENT CALIBRATION PROCEDURES
(Continued)

REFERENCES

(1) U S. Environmental Protection Agency, March 1983, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, Environmental Monitoring and Support Laboratory, U S EPA, Cincinnati, Ohio.

(2) U S Environmental Protection Agency, April 1984, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 2nd Edition

(3) U S Environmental Protection Agency, 1984, "Proposed Sampling and Analytical Methodologies for Addition to Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," PB85-103026

(4) Standard procedures as listed in the manufacturer's literature

(5) 40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants "

(6) U.S. Environmental Protection Agency (EPA), December 1984, "Characterization of Hazardous Waste Sites - A Methods Manual, Volume II, Available Sampling Methods," EPA-600/4-84-076

(7) U.S. Environmental Protection Agency (EPA), November 1986, "Chemical Analytical Services for Organics Applying GC/MS Techniques," WS-87-J002

(8) APHA, AWWA, WPCE Joint Editorial Board, 1985, "Standard Methods for the Examination of Water and Wastewater" 16th Edition.

(9) Material Engineering and Testing Co., Greensburg, Pa., "Quality Assurance Procedures C295 - Petrographic Examination," April 7, 1977, Rev September 9, 1985.

TABLE 4 2

LABORATORY AND FIELD EQUIPMENT CALIBRATION PROCEDURES

INSTRUMENT/EQUIPMENT	MANUFACTURER AND MODEL[a]	CALIBRATION REFERENCE	CALIBRATION FREQUENCY
Low Background Alpha/Beta Counting System	Tennelec, Model LB5100	1,2,3,4,5,6,7,8	Daily[b]
Scaler Scintillation Counter	Ludlum, Model 1000	1,2,3,4,5,6,7,8	Weekly
Scaler Scintillation Counter	Ludlum, Model 2000	1,2,3,4,5,6,7,8	Weekly
Scaler Scintillation Counter	Ludlum, Model 2200	1,2,3,4,5,6,7,8	Weekly
Alpha Spectrometer	Tennelec, Model 256	2,3,4,5	Weekly
Multichannel Analyzer	Tracor Norther, Model 7200	2,3,4,5	Daily
Computer Based Gamma Spectrometer (Data System Only)	Nuclear Data, Model ND682	2,3,4,5	Monthly as a single unit
Tri-Carb Liquid Scintillation Spectrometer	Packard, Model 3255	9	Daily
Series 90, Alpha, Beta, Gamma Spectroscopy System	Canberra, Model 2404F	2,3,4,5	Daily
Quad Spectra Particle Detection Unit	Canberra, Model 7401	2,3,4,5	Daily

[a]This equipment, or its equivalent, shall be used

[b]Each day samples are analyzed.

REFERENCES

(1) Krieger, H.L. and E.L. Whittaker, August 1980, "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032 (1980 Update), U S Environmental Protection Agency (U.S EPA)

(2) Kraus, K.A. and C E. Moore, 1955, "The Separation of Pa (V) and Fe (III) with HCl Mixtures," Journal of American Chemical Society 77, 1383

(3) Wish, Leon, March 1959, "Quantitative Radiochemical Analysis by Ion Exchange," Analytical Chemistry 31, 326-329.

(4) Campbell, E.E. and W D. Moss, October 10-11, 1963, "Determination of Plutonium in Urine by Ion Exchange," Proceedings of the Ninth Annual Conference on Bioassay and Analytical Chemistry, San Diego, California.

(5) Henley, L C., May 1978, Radiochemical Procedures of the Industrial Safety and Applied Health Physics Division, Oak Ridge National Laboratory, ORNL/TM-6372

(6) Hume, D.N , N E. Ballou, and L.E. Gendenin, June 1945, CN-2815, pp 23-26

(7) Swift, E.H., 1940, A System of Chemical Analysis, Prentice-Hall, New York, p. 376

(8) Willard, H H. and E.W. Goodspeed, 1936, "Separation of Strontium, Barium, and Lead from Calcium and Other Metals," Ind. Eng. Chem , Anal Ed , 8, 414

(9) Anders, Edward, November 1960, The Radiochemistry of Technetium, National Academy of Sciences - National Research Council.

TABLE 5 1

SAMPLING AND PRESERVATION REQUIREMENTS
FOR WATER SAMPLES

PARAMETER	METHOD (1,2,3,4,5,6,7,8,)	CONTAINERS*, FILTRATION, PRESERVATIVES (9,11)	MAXIMUM HOLDING TIMES (3,4,9)
INORGANICS			
ANIONS			
ALKALINITY (HCO3- AND CO32-)	403	P/G, UF	14 DAYS
CHLORIDE	325 3,407C	P/G, UF	28 DAYS
CYANIDE	CLP SOW (4)	P/G, UF, NAOH pH>12	14 DAYS
FLUORIDE	340 2	P/G, UF	28 DAYS
NITRATE	352.1,(5)	P/G, UF	28 DAYS
SULFATE	375.4	P/G, UF	28 DAYS
METALS			
ALUMINUM	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
ANTIMONY	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
ARSENIC	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
BARIUM	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
BERYLLIUM	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
CADMIUM	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
CALCIUM	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
CESIUM	200.7	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
CHROMIUM	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
COBALT	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
COPPER	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
IRON	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
LEAD	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
MAGNESIUM	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
MANGANESE	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
MERCURY	CLP SOW (4)	G, F, HNO3 pH<2, Cool 4°C	26 DAYS
MOLYBDENUM	200.7,246 1	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
NICKEL	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
POTASSIUM	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
SELENIUM	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
SILVER	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
SODIUM	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
STRONTIUM	303A	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
THALLIUM	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
VANADIUM	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS
ZINC	CLP SOW (4)	P/G, F, HNO3 pH<2, Cool 4°C	6 MONTHS

TABLE 5-1 (CONT)

SAMPLING AND PRESERVATION REQUIREMENTS
FOR WATER SAMPLES

PARAMETER	METHOD (1,2,3,4,5,6,7,8)	CONTAINERS*, FILTRATION, PRESERVATIVES (9,11)	MAXIMUM HOLDING TIMES (3,4,9)
ORGANICS			
HSL VOLATILE ORGANICS	CLP SOW (3)	G-AMBER-2,40 ML, TEFLON-LINED SEPTUM, COOL 4°	10 DAYS, (12)
RADIONUCLIDES			
GROSS ALPHA	900 0,703	P,F 1000 ML HNO3 pH<2	6 MONTHS
GROSS BETA	302	P,F 1000 ML HNO3 pH<2	6 MONTHS
URANIUM ISOTOPES	ASTM D-2907	P,F 1000 ML HNO3 pH<2	6 MONTHS
AMERICIUM-241	RSL 102, 201, 304	P,G 1000 ML HNO3 pH<2	6 MONTHS
PLUTONIUM-239,240	RSL 102, 201, 304	P,F 1000 ML HNO3 pH<2	6 MONTHS
TRITIUM	306	G,UF,NO HEADSPACE	

1) EPA HANDBOOK OF TEST METHODS, EPA-600 4-82-055, 1983
2) TEST METHODS FOR EVALUATING SOLID WAS E, SW-846, NOVEMBER 1986
3) CONTRACT LABORATORY PROGRAM ORGANIC STATEMENT OF WORK, OCTOBER 1986
4) CONTRACT LABORATORY PROGRAM INORGANIC STATEMENT OF WORK, JULY 1987
5) QUICK CHEM METHOD NUMBER 10-204-00-1-A,LACHAT INSTRUMENTS 1987
6) QUICK CHEM METHOD NUMBER. 10-107-04-1-A,LACHAT INSTRUMENTS 1987
7) AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS, SECTION 11, VOLS 11 01 AND 11 02
8) STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER 1985, SIXTEENTH EDITION
9) CODE OF FEDERAL REGULATIONS 40 CFR 136 JULY 1987, PP 264-265
10) RADIOLOGICAL SCIENCES LABORATORY METHODS (IT CORPORATION, 1987)
11) P=PLASTIC, G=GLASS, F=FILTERED 0.45 MICRON, UF=UNFILTERED
12) FROM VALIDATED TIME OF SAMPLE RECEIPT
* 500 ML OF GROUND WATER REQUIRED FOR METALS, 1000 ML REQUIRED FOR ANIONS, OTHER VOLUMES AS NOTED

TABLE 5 2

SAMPLING AND PRESERVATION REQUIREMENTS
FOR SOIL SAMPLES

PARAMETER	METHOD (1,2,3,4,5,6,7,8)	CONTAINERS* AND PRESERVATIVE (9,11)	MAXIMUM HOLDING TIMES,(3,4,9)
INORGANICS			
ANIONS			
ALKALINITY (HCO3- AND CO32-)	(13) 403	GLASS, COOL 4°C	14 DAYS
CHLORIDE	(13),325 3,407C	GLASS, COOL 4 C	28 DAYS
CYANIDE	CLP SOW (4)	GLASS, COOL 4 C	14 DAYS
FLUORIDE	(13),340 2	GLASS, COOL 4 C	28 DAYS
NITRATE	(13),352 1	GLASS, COOL 4°C	28 DAYS
SULFATE	(13),375 4	GLASS, COOL 4°C	28 DAYS
METALS			
ALUMINUM	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
ANTIMONY	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
ARSENIC	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
BARIUM	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
BERYLLIUM	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
CADMIUM	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
CALCIUM	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
CESIUM	200 7	P/G, COOL 4°C	6 MONTHS
CHROMIUM	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
COBALT	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
COPPER	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
IRON	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
LEAD	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
MAGNESIUM	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
MANGANESE	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
MERCURY	CLP SOW (4)	G, COOL 4°C	26 DAYS
MOLYBDENUM	3050,200.7,7481	P/G, COOL 4°C	6 MONTHS
NICKEL	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
POTASSIUM	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
SELENIUM	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
SILVER	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
SODIUM	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
STRONTIUM	303A	P/G, COOL 4°C	6 MONTHS
THALLIUM	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
VANADIUM	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS
ZINC	CLP SOW (4)	P/G, COOL 4°C	6 MONTHS

TABLE 5 2 (CONT)

SAMPLING AND PRESERVATION REQUIREMENTS
FOR SOIL SAMPLES

PARAMETER	METHOD (1,2,3,4,5,6,7,8)	CONTAINERS* AND PRESERVATIVE (9,11)	MAXIMUM HOLDING TIMES,(3,4,9)
ORGANICS			
HSL VOLATILE ORGANICS	CLP SOW (3)	G-500 ML, TEFLON-LINED SEPTUM/SHELBY TUBE COOL, 4°C	10 DAYS, (12)

(12)

RADIONUCLIDES			
GROSS ALPHA	9310	P-1000 ML pH<2	6 MONTHS
GROSS BETA	9310	P-1000 ML pH<2	6 MONTHS
URANIUM ISOTOPES	9315	P-1000 ML pH<2	6 MONTHS
AMERICIUM-241	RSL 102, 201, 304	P-1000 ML pH<2	6 MONTHS
PLUTONIUM-239,240	RSL 102, 201, 304	P-1000 ML pH<2	6 MONTHS

1) EPA HANDBOOK OF TEST METHODS, EPA-600/4-82-055, 1983
2) TEST METHODS FOR EVALUATING SOLID WASTE, SW-846, NOVEMBER 1986
3) CONTRACT LABORATORY PROGRAM ORGANIC STATEMENT OF WORK, OCTOBER 1986
4) CONTRACT LABORATORY PROGRAM INORGANIC STATEMENT OF WORK, JULY 1987
5) QUICK CHEM METHOD NUMBER 10-204-00-1-A,LACHAT INSTRUMENTS 1987
6) QUICK CHEM METHOD NUMBER 10-107-04-1-A,LACHAT INSTRUMENTS 1987
7) AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS, SECTION 11, VOLS 11 01 AND 11 02
8) STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER 1985, SIXTEENTH EDITION
9) CODE OF FEDERAL REGULATIONS 40 CFR 136 JULY 1987, PP 264-265
10) RADIOLOGICAL SCIENCES LABORATORY METHODS (IT CORPORATION, 1987)
11) P=PLASTIC, G=GLASS, F=FILTERED, UF=UNFILTERED
12) FROM VALIDATED TIME OF SAMPLE RECEIPT
13) SOIL EXTRACTION FOR COMMON ANIONS ITAS-EXPORT LABORATORY, 1985

TABLE 7 1

ANALYTICAL METHODS, DETECTION LIMITS AND REFERENCES
WATER SAMPLES

PARAMETER	METHOD (1,2,3,4,5,6,7,8)	EXPECTED METHOD DETECTION LIMIT (1,2,3,4,5,6,7,8)
INORGANICS		
ANIONS		
ALKALINITY (HCO3- AND CO32-)	403 (8)	1 mg/l
CHLORIDE	407C(8)	1 mg/l
CYANIDE	CLP SOW (4)	0 010 mg/l
FLUORIDE	340.2(14)	0 1 mg/l
NITRATE	352 1,(5)	0 1 mg/l
SULFATE	375 4(14)	1 mg/l
METALS		
ALUMINUM	CLP SOW (4)	0 2 mg/l
ANTIMONY	CLP SOW (4)	0 06 mg/l
ARSENIC	CLP SOW (4)	0 01 mg/l
BARIUM	CLP SOW (4)	0 2 mg/l
BERYLLIUM	CLP SOW (4)	0 005 mg/l
CADMIUM	CLP SOW (4)	0 005 mg/l
CALCIUM	CLP SOW (4)	5 mg/l
CESIUM	303A (8)	0 01 mg/l
CHROMIUM	CLP SOW (4)	0 01 mg/l
COBALT	CLP SOW (4)	0 05 mg/l
COPPER	CLP SOW (4)	0 025 mg/l
IRON	CLP SOW (4)	0 1 mg/l
LEAD	CLP SOW (4)	0 005 mg/l
MAGNESIUM	CLP SOW (4)	5 mg/l
MANGANESE	CLP SOW (4)	0 015 mg/l
MERCURY	CLP SOW (4)	0 0002 mg/l
MOLYBDENUM	246.1 (14)	0 1 mg/l
NICKEL	CLP SOW (4)	0 04 mg/l
POTASSIUM	CLP SOW (4)	40 mg/l
SELENIUM	CLP SOW (4)	0.005 mg/l
SILVER	CLP SOW (4)	0 01 mg/l
SODIUM	CLP SOW (4)	40 mg/l
STRONTIUM	303A (14)	0 01 mg/l
THALLIUM	CLP SOW (4)	0 01 mg/l
VANADIUM	CLP SOW (4)	0 05 mg/l
ZINC	CLP SOW (4)	0 02 mg/l

TABLE 7 1 (CONT)

ANALYTICAL METHODS, DETECTION LIMITS AND REFERENCES
WATER SAMPLES

PARAMETER	METHOD (1,2,3,4,5,6,7,8)	EXPECTED METHOD DETECTION LIMIT (1,2,3,4,5,6,7,8)
ORGANICS		
HSL VOLATILE ORGANICS	CLP SOW (3)	5/10 UG/L
RADIONUCLIDES		
GROSS ALPHA	900.0,703	0 3 pCi/L
GROSS BETA	302	0 4 pCi/L
URANIUM ISOTOPES	ASTM D-2907	0 3 pCi/L
AMERICIUM-241	RSL 102, 201, 304 (10)	05 pCi/L
PLUTONIUM-239,240	RSL 102, 201, 304, (10)	05 pCi/L
TRITIUM	306	500 pCi/L

1) EPA HANDBOOK OF TEST METHODS, EPA-600/4-82-055, 1983
2) TEST METHODS FOR EVALUATING SOLID WASTE, SW-846, NOVEMBER 1986
3) CONTRACT LABORATORY PROGRAM ORGANIC STATEMENT OF WORK, OCTOBER 1986
4) CONTRACT LABORATORY PROGRAM INORGANIC STATEMENT OF WORK, JULY 1987
5) QUICK CHEM METHOD NUMBER 10-204-00-1-A,LACHAT INSTRUMENTS 1987
6) QUICK CHEM METHOD NUMBER 10-107-04-1-A,LACHAT INSTRUMENTS 1987
7) AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS, SECTION 11, VOLS 11 01 AND 11 02
8) STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER 1985, SIXTEENTH EDITION
9) CODE OF FEDERAL REGULATIONS 40 CFR 136 JULY 1987, PP 264-265
10) RADIOLOGICAL SCIENCES LABORATORY METHODS (IT CORPORATION, 1987)
11) P=PLASTIC, G=GLASS, F=FILTERED, UF=UNFILTERED
12) FROM VALIDATED TIME OF SAMPLE RECEIPT
13) SOIL EXTRACTION FOR COMMON ANIONS, ITAS-EXPORT LABORATORY, 1985
14) METHODS FOR THE CHEMICAL ANALYSES OF WATER AND WASTE, EPA-600/4-79-020, MARCH 1983

TABLE 7 2

ANALYTICAL METHODS, DETECTION LIMITS AND REFERENCES
SOIL SAMPLES

PARAMETER	METHOD (1,2,3,4,5,6,7,8)	EXPECTED METHOD DETECTION LIMIT (1,2,3,4,5,6,7,8)
INORGANICS		
ANIONS		
ALKALINITY (HCO3- AND CO32-)	(13), 403	10 mg/kg
CHLORIDE	(13), 325 3,407C	10 mg/kg
CYANIDE	CLP SOW (4)	1 0 mg/kg
FLUORIDE	(13), 340 2	1 0 mg/kg
NITRATE	(13), 352 1	1 0 mg/kg
SULFATE	(13), 375 4	10 mg/kg
METALS		
ALUMINUM	CLP SOW (4)	20 mg/kg
ANTIMONY	CLP SOW (4)	6 mg/kg
ARSENIC	CLP SOW (4)	1 mg/kg
BARIUM	CLP SOW (4)	20 mg/kg
BERYLLIUM	CLP SOW (4)	0.5 mg/kg
CADMIUM	CLP SOW (4)	0 5 mg/kg
CALCIUM	CLP SOW (4)	5 mg/kg
CESIUM	303A (8)	1 mg/kg
CHROMIUM	CLP SOW (4)	1 mg/kg
COBALT	CLP SOW (4)	5 mg/kg
COPPER	CLP SOW (4)	2 5 mg/kg
IRON	CLP SOW (4)	10 mg/kg
LEAD	CLP SOW (4)	0 5 mg/kg
MAGNESIUM	CLP SOW (4)	5 mg/kg
MANGANESE	CLP SOW (4)	1 5 mg/kg
MERCURY	CLP SOW (4)	02 mg/kg
MOLYBDENUM	246 1 (14)	10 mg/kg
NICKEL	CLP SOW (4)	4 mg/kg
POTASSIUM	CLP SOW (4)	5 mg/kg
SELENIUM	CLP SOW (4)	0 5 mg/kg
SILVER	CLP SOW (4)	1 mg/kg
SODIUM	CLP SOW (4)	5 mg/kg
STRONTIUM	303A (8)	1 mg/kg
THALLIUM	CLP SOW (4)	1 0 mg/kg
VANADIUM	CLP SOW (4)	5 0 mg/kg
ZINC	CLP SOW (4)	2 0 mg/kg

TABLE 7 2 (CONT)

ANALYTICAL METHODS, DETECTION LIMITS AND REFERENCES
SOIL SAMPLES

PARAMETER	METHOD (1,2,3,4,5,6,7,8)	EXPECTED METHOD DETECTION LIMIT (1,2,3,4,5,6,7,8)
ORGANICS		
HSL VOLATILE ORGANICS	CLP SOW (3)	5/10 ug/kg
RADIONUCLIDES		
GROSS ALPHA	9310	0 3 pCi/L
GROSS BETA	9310	0 4 pCi/L
URANIUM ISOTOPES	9315	0 3 pCi/L
AMERICIUM-241	RSL 102, 201, 304	05 pCi/L
PLUTONIUM 239, 240	RSL 102, 201, 304	.05 pCi/L
TRITIUM	306	500 pCi/L

1) EPA HANDBOOK OF TEST METHODS, EPA-600/4-82-055, 1983
2) TEST METHODS FOR EVALUATING SOLID WASTE, SW-846, NOVEMBER 1986
3) CONTRACT LABORATORY PROGRAM ORGANIC STATEMENT OF WORK, OCTOBER 1986
4) CONTRACT LABORATORY PROGRAM INORGANIC STATEMENT OF WORK, JULY 1987
5) QUICK CHEM METHOD NUMBER 10-204-00-1-A,LACHAT INSTRUMENTS 1987
6) QUICK CHEM METHOD NUMBER 10-107-04-1-A,LACHAT INSTRUMENTS 1987
7) AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS, SECTION 11, VOLS 11 01 AND 11 02
8) STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER 1985, SIXTEENTH EDITION
9) CODE OF FEDERAL REGULATIONS 40 CFR 136 JULY 1987, PP 264-265
10) RADIOLOGICAL SCIENCES LABORATORY METHODS (IT CORPORATION, 1987)
11) P=PLASTIC, G=GLASS, F=FILTERED, UF=UNFILTERED
12) FROM VALIDATED TIME OF SAMPLE RECEIPT
13) SOIL EXTRACTION FOR COMMON ANIONS ITAS-EXPORT LABORATORY, 1985
14) METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTE, EPA-600/4-79-020, MARCH 1983

TABLE 7 3

HAZARDOUS SUBSTANCE LIST (HSL) PARAMETERS

PRIORITY POLLUTANTS· VOLATILE COMPOUNDS

benzene
bromoform
bromomethane
bromodichloromethane
carbon tetrachloride
chlorobenzene
dibromochloromethane
chloroethane
2-chloroethylvinyl ether
chloroform
chloromethane
cis-1,3-dichloropropene
1,1,-dichloroethane
1,2-dichloroethane
1,1-dichloroethene
1,2-dichloropropane
ethylbenzene
methylene chloride
1,1,2,2-tetrachloroethane
tetrachloroethene
toluene
trans-1,2-dichloroethene
trans-1,3-dichloropropene
1,1,1-trichloroethane
1,1,2-trichloroethane
trichloroethene
vinyl chloride

PRIORITY POLLUTANTS ACID EXTRACTABLES

4-chloro-3-methylphenol
2-chlorophenol
2,4-dichlorophenol
2,4-dimethylphenol
2,4-dinitrophenol
2-methyl-4,6-dinitrophenol
2-nitrophenol
4-nitrophenol
pentachlorophenol
phenol
2,4,6-trichlorophenol

PRIORITY POLLUTANTS: BASE/NEUTRAL EXTRACTABLES

acenaphthene
acenaphthylene
anthracene
benzidine
benzo(a)anthracene
benzo(a)pyrene
benzo(b)fluoranthene
benzo(ghi)perylene
benzo(k)fluoranthene
bis(2-chloroethoxy)methane
bis(2-chloroethyl)ether
bis(2-chloroisopropyl)ether
bis(2-ethylhexyl)phthalate
4-bromopnenyl phenyl ether
butylbenzyl phthalate
2-chloronapthalene
4-chlorophenyl phenyl ether
chrysene
dibenzo(a,h)anthracene
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
3,3'-dichlorobenzidine
diethyl phthalate
dimethyl phthalate
di-n-butyl phthalate
2,4-dinitrotoluene
2,6-dinitrotoluene
di-n-octyl phthalate
fluoranthene
fluorere
hexachlorobenzene
hexachlorobutadiene
hexachlorocyclopentadiene
hexachloroethane
indeno(1,2,3-cd) pyrene
isophorone
naphthalene
nitrobenzene
N-nitrosodimethylamine
N-nitrosodi-n-propylamine
N-nitrosodiphenylamine
phenanthrene
1,2,4-trichlorobenzene
pyrene

TABLE 7 3
(Continued)

PRIORITY POLLUTANTS PESTICIDES AND PCBS

aldrin
alpha-BHC
beta-BHC
delta-BHC
chlordane
4,4'-DDD
4,4'-DDE
4,4'-DDT
dieldrin
alpha-endosulfan
beta-endosulfan
endosulfan sulfate
endrin
endrin aldehyde
endrin ketone
heptachlor
heptachlor epoxide
lindane
methoxychlor
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
toxaphene

NONPRIORITY POLLUTANTS VOLATILE COMPOUNDS

acetone
2-butanone
carbon disulfide
2-hexanone
4-methyl-2-pentanone
styrene
vinyl acetate
total xylenes

NONPRIORITY POLLUTANTS ACID EXTRACTABLES

benzoic acid
2-methylphenol
4-methylphenol
2,4,5-trichlorophenol

NONPRIORITY POLLUTANTS: BASE/NEUTRAL EXTRACTABLES

aniline
benzyl alcohol
4-chloroaniline
dibenzofuran
2-methylnaphthalene
2-nitroaniline
3-nitroaniline
4-nitroaniline

TABLE 8-1

PROJECT CENTRAL FILE CATEGORIES

CORRESPONDENCE	LETTER DESIGNATION	CONTENT EXAMPLES
Correspondence	A	Organized by subcategories including incoming and outgoing letters, memos, telexes, telephone conversation records, etc
"Blank"	B	This category may be used for a project-specific need
Originals	C	Typed originals for reports, regulatory submittals, proposals, etc
Bids, Contracts, and Specifications	D	All bids, proposals, contrcts, purchase orders for services, and specification
Field Data and Their Checkprints	E	Subsurface logs, calibration records, daily field logs, sample collection forms, waste handling data, etc This includes information generated by the field personnel at the site, with the exception of health and safety records.
Calculations and Their Checkprints	F	Each set of calculations and checkprints should be placed in the same folder, if possible
Reports from Others	G	Reports received from Rockwell or reports by other organizations
Contractor Reports	H	Prepared bound reports produced by the contractor
Photographs	I	Photographs taken of field activities
Miscellaneous	J	By project needs for special circumstances

TABLE B 1

(Continued)

CORRESPONDENCE	LETTER DESIGNATION	CONTENT EXAMPLES
Laboratory Data and Their Checkprints	K	Laboratory test data and results summaries
Licensing and Permitting Applications	L	Regulatory permits and legal instruments
Reference Material	M	Outside literature, maps, etc
Site Monitoring Records	N	Industrial hygiene such as personnel, area, and perimeter sampling and monitoring.
Drawing and Table Checkprints	O	Checkprints for drawings, figures, sketches, and tables
Management Records	P	Management Records related to the project progress, including job tracking reports
Quality Records	Q	Project quality records including nonconformances, variances, audit reports and responses

QUALITY ASSURANCE PROJECT PLAN

FIGURES

DAILY LOG				
	DATE			
	NO			
	SHEET		OF	

FIELD ACTIVITY DAILY LOG

PROJECT NAME	PROJECT NO
FIELD ACTIVITY SUBJECT	
DESCRIPTION ON DAILY ACTIVITIES AND EVENTS	
VISITORS ON SITE	CHANGES FROM PLANS AND SPECIFICATIONS AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS
WEATHER CONDITIONS	IMPORTANT TELEPHONE CALLS
PERSONNEL ON SITE	
SUPERVISOR	DATE

327 7 86

FIGURE 5 1

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER	PROJECT NAME	
BORING NUMBER	COORDINATES	DATE
ELEVATION	GWL Depth Date/Time	DATE STARTED
ENGINEER/GEOLOGIST	Depth Date/Time	DATE COMPLETED
DRILLING METHODS		PAGE OF

DEPTH	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER	RECOVERY	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS

NOTES

FIGURE 5 2

PIEZOMETER INSTALLATION SHEET

PROJECT NAME _____ FIELD ENG /GEO _____ DATE _____
PROJECT NO. _____ CHECKED BY _____ DATE _____
BORING NO. _____
PIEZOMETER NO _____ DATE OF INSTALLATION _____

BOREHOLE DRILLING

DRILLING METHOD _____	TYPE OF BIT _____
DRILLING FLUID (S) USED	CASING SIZE (S) USED
FLUID _____ FROM _____ TO _____	SIZE _____ FROM _____ TO _____
FLUID _____ FROM _____ TO _____	SIZE _____ FROM _____ TO _____

PIEZOMETER DESCRIPTION

TYPE _____	RISER PIPE MATERIAL _____
DIAMETER OF PERFORATED SECTION _____	RISER PIPE DIAMETERS
PERFORATION TYPE	O D _____ I D _____
SLOTS ☐ HOLES ☐ SCREEN ☐	LENGTH OF PIPE SECTIONS _____
AVERAGE SIZE OF PERFORATIONS _____	JOINING METHOD _____
TOTAL PERFORATED AREA _____	

PROTECTION SYSTEM

RISER PROTECTIVE PIPE LENGTH _____	OTHER PROTECTION _____
PROTECTIVE PIPE O D _____	

ITEM	DISTANCE ABOVE/BELOW GROUND SURFACE ( )		ELEVATION ( )	
TOP OF RISER PIPE				
GROUND SURFACE	O O			
BOTTOM OF PROTECTIVE PIPE				
BOREHOLE FILL MATERIALS.				
GROUT/SLURRY	TOP	BOTTOM	TOP	BOTTOM
BENTONITE	TOP	BOTTOM	TOP	BOTTOM
SAND	TOP	BOTTOM	TOP	BOTTOM
GRAVEL	TOP	BOTTOM	TOP	BOTTOM
PERFORATED SECTION	TOP	BOTTOM	TOP	BOTTOM
PIEZOMETER TIP				
BOTTOM OF BOREHOLE				
GWL AFTER INSTALLATION				

WAS THE PIEZOMETER FLUSHED AFTER INSTALLATION? YES ☐ NO ☐
WAS A SENSITIVITY TEST PERFORMED ON THE PIEZOMETER? YES ☐ NO ☐
REMARKS _____

FIGURE 5 3

PIEZOMETER DATA SHEET

PROJECT NAME _____ PROJECT NO _____

(1) DEPTH TO THE WATER LEVEL FROM THE TOP OF PIPE
(2) ELEVATIONS SHOWN ARE TOP OF PIEZOMETER PIPE

DATE & RECORDER	PIEZOMETER READINGS - FEET (1)										
	# EL (2)	# EL	# EL	# EL	# EL	# EL	# EL	# EL	# EL	# EL	# EL
	ELEVATION OF WATER LEVEL - FEET										

FIGURE 5.4

FIELD PERMEABILITY TESTS

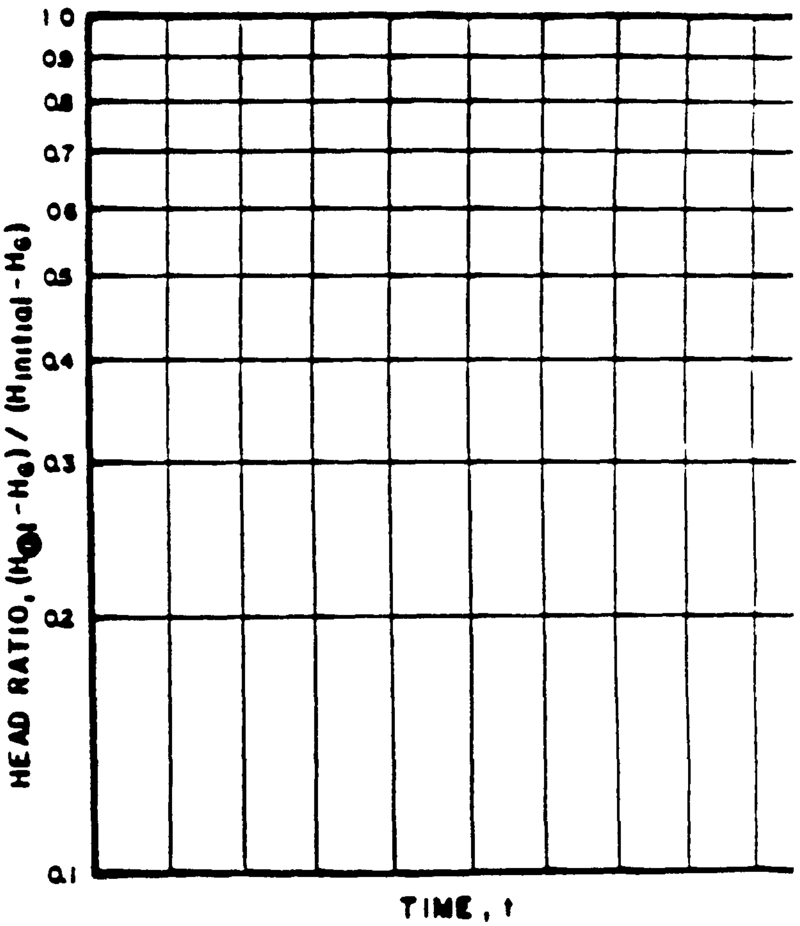
FALLING HEAD *

PROJECT ______________________ TESTED BY ______________ DATE ______________
PROJECT NO ______________________ CALCULATED BY ______________ DATE ______________
BORING NO ______________________ CHECKED BY ______________ DATE ______________

RADIUS OF TEST BORING, R ______________________ PERMEABILITY, K ______________
HEIGHT OF CASING (REF LEVEL)
ABOVE GROUND SURFACE, H_C ______________________
DEPTH TO BOTTOM OF TEST POCKET, L_1 ______________________
DEPTH TO TOP OF TEST POCKET, L_2 ______________________
DEPTH TO GROUNDWATER TABLE
FROM TOP OF CASING, H_e ______________________

*CASED HOLE, UNCASED OR PERFORATED EXTENSION OF LENGTH, $L_1 - L_2$

ELAPSED TIME t SEC	DEPTH TO WATER IN CASING H Meters



H_1 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_1

H_2 = DEPTH TO WATER IN CASING FROM TOP OF CASING AT TIME, t_2

$$K = \frac{R^2}{2(L_1 - L_2)(t_2 - t_1)} \ln\left[\frac{L_1 - L_2}{R}\right] \ln\left[\frac{H_1 - H_e}{H_2 - H_e}\right]$$

NOTE: THE EQUATION ASSUMES THE HORIZONTAL AND VERTICAL PERMEABILITIES ARE EQUAL

FIGURE 5 5

DATE	
TIME	
PAGE ____ OF ____	
PAGE	
PROJECT NO	

SAMPLE COLLECTION LOG

PROJECT NAME _____

SAMPLE NO _____

SAMPLE LOCATION _____

SAMPLE TYPE _____

COMPOSITE ____YES ____NO

COMPOSITE TYPE _____

DEPTH OF SAMPLE _____

WEATHER _____

CONTAINERS USED	AMOUNT COLLECTED

COMMENTS

PREPARED BY _____

FIGURE 5 6

(CONT)

COMMENTS
(Continued)

DATE						
TIME						
PAGE ____ OF ____						
PAGE						
PROJECT NO						

PREPARED BY _____

LEGEND

1 A SAMPLE COLLECTION LOG IS TO BE COMPLETED FOR EACH SAMPLE

2 ALWAYS COMPLETE BOTH SIDES IF SECOND SIDE IS NOT USED DRAW A LINE THROUGH IT AND MARK N/A FILL IN CONTROL BLOCK AND PREPARED BY

3 ALL ENTRIES ON LOG ARE TO BE COMPLETED IF NOT APPLICABLE MARK N/A

4 DATE USE MONTH/DAY/YEAR I E 10/30/86

5 TIME USE 24-HOUR CLOCK I E 1835 FOR 6 35 P M

6 PAGE EACH SAMPLE TEAM SHOULD NUMBER PAGE _____ OF _____ FOR THE DAY S ACTIVITIES FOR ALL SHEETS PREPARED ON A SINGLE DAY I E IF THERE ARE A TOTAL OF 24 PAGES (INCLUDING FRONT AND BACK) NUMBER 1 OF 24 2 OF 24 ETC

7 SAMPLE LOCATION USE BORING OR MONITORING WELL NUMBER GRID LOCATION (TRANSECT) SAMPLING STATION I D OR COORDINATE TO PHYSICAL FEATURES WITH DISTANCES INCLUDE SKETCH IN COMMENT SECTION IF NECESSARY

8 SAMPLE TYPE USE THE FOLLOWING - SOIL WATER (SURFACE OR GROUND) AIR (FILTERS TUBES AMBIENT PERSONNEL) SLUDGE DRUM CONTENTS OIL VEGETATION WIPE SEDIMENT

9 COMPOSITE TYPE I E 24-HOUR LIST SAMPLE NUMBERS IN COMPOSITE SPATIAL COMPOSITE

10 DEPTH OF SAMPLE GIVE UNITS WRITE OUT UNITS SUCH AS INCHES FEET DON T USE OR

11 WEATHER APPROXIMATE TEMPERATURE SUN AND MOISTURE CONDITIONS

12 CONTAINERS USED LIST EACH CONTAINER TYPE AS NUMBER VOLUME MATERIAL (E G 2 1L GLASS 4 40 ML GLASS VIAL 1 400 ML PLASTIC 1 3 INCH STEEL TUBE 1 - 8 OZ GLASS JAR)

13 AMOUNT COLLECTED VOLUME IN CONTAINERS (E G 1/2 FULL)

FIGURE 5-6 (cont.)

REQUEST FOR ANALYSIS

C/C Control No _____

PROJECT NAME _____

PROJECT NUMBER _____

PROJECT MANAGER _____

BILL TO _____

_____

_____

PURCHASE ORDER NO _____

DATE SAMPLES SHIPPED _____

LAB DESTINATION _____

LABORATORY CONTACT _____

SEND LAB REPORT TO _____

_____

_____

DATE REPORT REQUIRED _____

PROJECT CONTACT _____

PROJECT CONTACT PHONE NO _____

Sample No	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions

TURNAROUND TIME REQUIRED (Rush must be approved by the Project Manager)

Normal _____ Rush _____ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard _____ Flammable _____ Skin Irritant _____ Highly Toxic _____ Other _____ (Please Specify)

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis Lab will charge for packing shipping and disposal)

Return to Client _____ Disposal by Lab _____

FOR LAB USE ONLY

Received By _____ Date/Time _____

WHITE Original to accompany samples
YELLOW Field copy

FIGURE 5-7

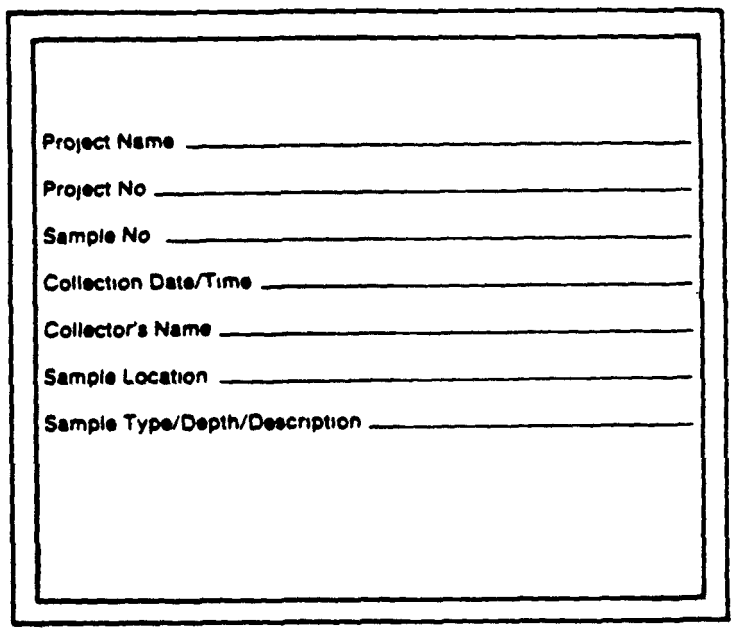


FIGURE 5-8

EXAMPLE SAMPLE LABEL

MONITORING WELL

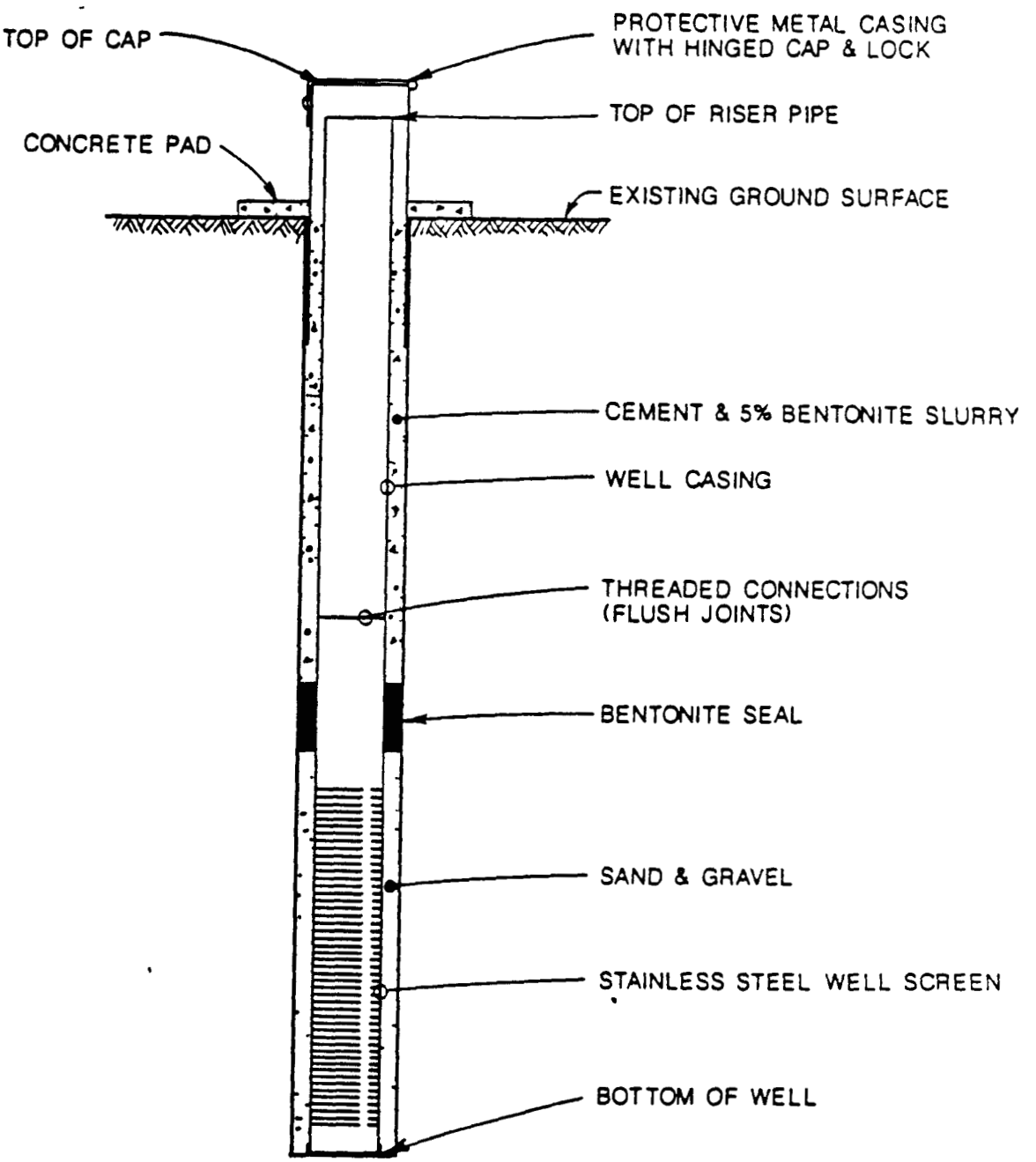


FIGURE 5-9

CHAIN-OF-CUSTODY RECORD

R/A Control No _____

C/C Control No 004300

PROJECT NAME/NUMBER _____ LAB DESTINATION _____

SAMPLE TEAM MEMBERS _____ CARRIER/WAYBILL NO _____

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container Type	Condition on Receipt (Name and Date)	Disposal Record No

FIGURE 6-1

Special Instructions _____

Possible Sample Hazards _____

SIGNATURES (Name, Company, Date and Time)

1 Relinquished By _____

Received By _____

2 Relinquished By _____

Received By _____

3 Relinquished By _____

Received by _____

4 Relinquished By _____

Received By _____

WHITE To accompany samples
YELLOW Field copy

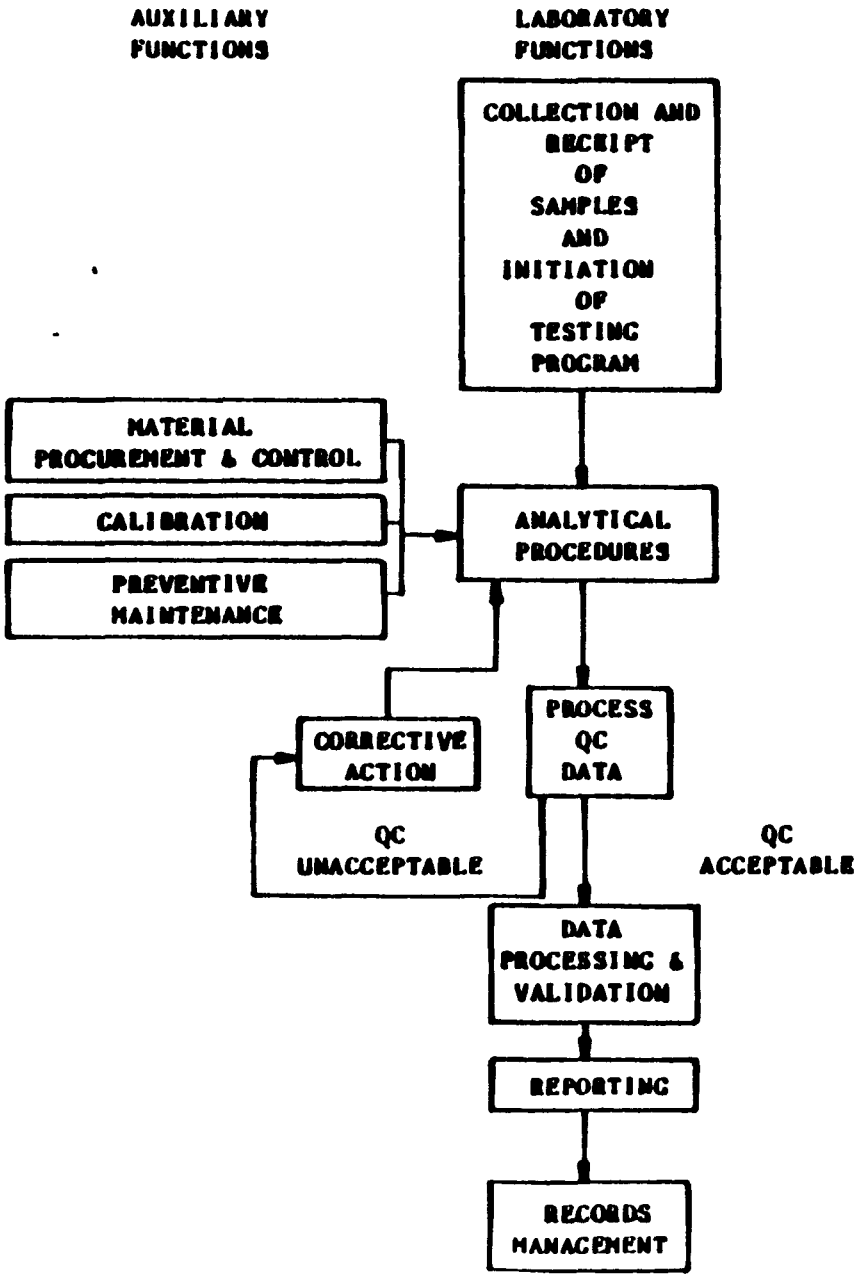

AUXILIARY FUNCTIONS
LABORATORY FUNCTIONS
COLLECTION AND RECEIPT OF SAMPLES AND INITIATION OF TESTING PROGRAM
MATERIAL PROCUREMENT & CONTROL
CALIBRATION
PREVENTIVE MAINTENANCE
ANALYTICAL PROCEDURES
CORRECTIVE ACTION
PROCESS QC DATA
QC UNACCEPTABLE
QC ACCEPTABLE
DATA PROCESSING & VALIDATION
REPORTING
RECORDS MANAGEMENT

FIGURE 7.1

QUALITY CONTROL SUMMARY SHEET

INORGANICS

PARAMETER _____

TESTED BY _____ DATE _____ PROJECT NAME _____

CALC BY _____ DATE _____ PROJECT NO. _____

CHECKED BY _____ DATE _____ SHEET NO. ____ OF ____

Duplicates Units _____

Sample Number _____

A. Original Sample Conc _____

B. Duplicate Sample Conc _____

C. Mean = $\frac{A + B}{2}$ = _____

D. Range = [A - B] = _____

E. Relative Percent Difference = $\frac{D}{C}$ x 100 = _____

Check Q

D. True Value of Q Standard = _____

E. Observed Value of Q = _____

F. Percent Recovery = $\frac{E}{D}$ x 100 = _____

Spiked Sample

Sample Number _____ Spike Source _____

A. _____ mls of B. _____ ppm Spike to C. _____ mls Sample

D. True Value of Spike = $\frac{A \times B}{A + C}$ = _____

E. Observed Value of Spike + Sample = _____

F. Observed Value of Sample = _____

G. Percent Recovery = $\frac{E - F}{D}$ x 100 = _____

FIGURE 7 2

QUALITY CONTROL SUMMARY SHEET

ORGANICS

PARAMETER _____

TESTED BY _____ DATE _____ PROJECT NAME _____

CALC BY _____ DATE _____ PROJECT NO. _____

CHECKED BY _____ DATE _____ SHEET NO. ____ OF ____

Duplicates Units _____

Sample Number _____

A. Original Sample Conc _____

B. Duplicate Sample Conc _____

C. Mean = $\frac{A + B}{2}$ = _____

D. Range = [A - B] = _____

E. Relative Percent Difference = $\frac{D}{C}$ x 100 = _____

Spiked Sample

Sample Number _____ Spike Source _____

A. _____ mls of B. _____ ppm Spike to C. _____ mls Sample

D. Total Volume = _____

E. Amount of Sample (ml or g) = _____

F. Dilution Factor = _____

G. Spike Concentration in Sample $\frac{A \times B \times D \times F}{C \times E}$ = _____

H. Observed Value of Spike + Sample = _____

I. Observed Value of Sample = _____

J. Percent Recovery = $\frac{H - I}{G}$ x 100 = _____

FIGURE 7 3

WATER CONTENT TESTS
COMPUTER PROGRAM WATER1

PROJECT _____ TESTED BY _____ DATE _____

PROJECT NO. _____ CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

NO. OF BORINGS	DEPTH UNITS (b)
PROJECT NO.	BORING NO

(b) 0 - FEET
1 - METERS

++COMPUTER INPUT

+ +									
+ +	SAMPLE NUMBER								
+ +	DEPTH, m. or ft.								
+ +	TARE NUMBER								
+ +	WT TARE + WS, gm								
+ +	WT TARE + DS, gm								
	WT WATER, gm								
	WT TARE, gm								
	WT DS, gm								
	W, %								
	COMMENTS								

+ +									
+ +	SAMPLE NUMBER								
+ +	DEPTH, m. or ft								999
+ +	TARE NUMBER								0
+ +	WT TARE + WS, gm								0
+ +	WT TARE + DS, gm								
	WT WATER, gm								
	WT. TARE, gm								
	WT DS, gm								
	W, %								
	COMMENTS								

+ FOR COMPUTER USE ONLY

FIGURE 7 4

SPECTROPHOTOMETRIC ANALYSIS
PARAMETER _____

TESTED BY _____ DATE _____ PROJECT NAME _____

CALC. BY _____ DATE _____ PROJECT NO. _____

CHECKED BY _____ DATE _____ SHEET NO. ___ OF ___

INSTRUMENT				STANDARD LOT NO -			
STANDARD VALUE( )							
ABSORBANCE (1) (2)							

SAMPLE IDENTIFICATION	SAMPLE VOLUME ml (A)	SAMPLE ABS (B)	BLANK ABS (C)	CORRECTED SAMPLE ABS (D)	CONC. µg FROM CURVE (E)	REPORTE CONC ug/ml (F)

EQUATIONS

CORRECTED SAMPLE ABS, (D) = B - C CONC ug/ml (F) = $\frac{E}{A}$

COMMENTS: _____

FIGURE 7 5

GC/MS ANALYSIS

TESTED BY _____ DATE _____ PROJECT NAME _____

CALC. BY _____ DATE _____ PROJECT NO _____

CHECKED BY _____ DATE _____ SHEET NO ___ OF ___

SAMPLE NO. _____ FILE REFERENCE NO _____

INJECTION VOL. _____ EXTRACTION / DILUTION _____

	COMPOUND	QUANT MASS	AREA	RF	DILUTION FACTOR	µg/l	BLANK µg/l	CORRECTED CONC µg/l
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

EQUATION. CONC µg/l = AREA x RF x DILUTION FACTOR

CORRECTED CONC µg/l = CONC (µg/l) - BLANK (µg/l)

COMMENTS _____

FIGURE 7 6

VARIANCE NO _____

VARIANCE LOG

PROJECT NO. _____ PAGE ___ OF ___

PROJECT NAME _____ DATE _____

VARIANCE (INCLUDE JUSTIFICATION)

APPLICABLE DOCUMENT:

CC:

REQUESTED BY: _____ Date: _____

Approved By: _____ Date: _____
Project Manager

_____ Date: _____
Quality Assurance Officer

_____ Date: _____

FIGURE 8-1

NONCONFORMANCE REPORT

PROJECT NO. _____ PAGE ___ OF ___

PROJECT NAME _____ DATE _____

NONCONFORMANCE

IDENTIFIED BY: _____ DATE _____

CORRECTIVE ACTION REQUIRED

TO BE PERFORMED BY: _____ DATE _____

MUST CORRECTION BE VERIFIED? YES ____ NO ____

TO BE VERIFIED BY: _____ PREPARED BY: _____ DATE: _____

CORRECTIVE ACTION TAKEN:

PERFORMED BY. _____ DATE _____

VERIFIED BY. _____ DATE: _____

CC

Approved By _____ Date _____

_____ Date: _____

FIGURE 8 2